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Space
Administration

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NASA's 20th Anniversary

The National Aeronautics and Space Administration Marks Two Decades of Aerospace Exploration and Research

Improving the Quality of Life on the Planet Earth

RELEASE NO: 78-133 October 1978

NOTE TO EDITORS:

NASA is observing its 20th anniversary. The space agency opened for business on Oct. 1, 1958.

The information attached summarizes what has been achieved in these 20 years. It was prepared as an aid to broadcasters, writers and editors who need historical, statistical and chronological material.

Those needing further information may call or write: NASA Headquarters, Code LFD-10, Public Information Services Branch, Washington, D.C. 20546; 202/755-8370. Photographs to illustrate any of this material may be obtained by calling or writing: NASA Headquarters, Code LFB-10, Audio-Visual Services Branch, Washington, D.C. 20546; 202/755-8366.

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CONTENTS

NASA News

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SPACE AGENCY NOTES 20TH ANNIVERSARY

By
Dr. Robert A. Frosch
NASA Administrator

(Editor's Note: This summation of the National Aeronautics and Space Administration's 20 years of work was prepared by Dr. Frosch for the October issue of NASA Activities, which is published monthly by NASA for the information of the Agency's employees.)

SPACE AGENCY NOTES 20TH ANNIVERSARY

By
Dr. Robert A. Frosch
NASA Administrator

By the time a man or a woman has lived for 20 years, a new individuality has been established, physical maturity has been achieved, important experiences have been undergone and digested, there have been some triumphs and some tragedies, the outlines of the individual's role in society are beginning to come into focus, and it becomes possible to do some sensible planning and make some educated guesses about the future. Most importantly, a unique new entity with largely undetermined potential has come to exist in the world.

-more-

On its 20th anniversary, NASA -- composed of some 23,000 men and women -- is just such an entity. We are a unique agency, mandated by the people of our country through their elected representatives to develop and utilize space technology both for immediate practical application and to expand our knowledge of the Earth, its environment, the solar system and the universe. We are charged with assisting the Department of Defense in the use of space to maintain the security of our nation, and with the promotion of international cooperation in space for peaceful purposes. An important part of our charter calls for research and development to maintain U.S. leadership in aeronautics, and to improve civil and military aeronautical vehicles while minimizing their energy consumption and environmental degradation. We are further charged with the dissemination to all potential users of new knowledge and technology acquired in the course of all these activities, and, alone among Federal agencies, we are required by law to "provide for the widest practicable and appropriate dissemination of information concerning (our) activities and the results thereof."

As in the case of a 20-year-old person, we have achieved the approximate shape and size we can expect to live with for the foreseeable future; we have some learning experiences under our collective belts; we have tasted both triumph and tragedy, although happily more of the former than the latter; our functions in the interests of our people are beginning to come clear; and we are beginning to see some of the directions in which we may want to go in the years ahead.

Like any reasonably intelligent and normally healthy 20-year-old, we have reason to be proud of our accomplishments thus far and confident of further accomplishments in the future as we gain experience and knowledge.

We have, after all, in just two decades, for the first time ever, put life from the planet Earth on another body of our solar system, and in our explorations of the Moon learned more about the nature and origins of that system than humanity was able to determine in all the centuries that went before.

-more-

In those two eventful decades we have landed extensions of our intelligence on Mars, begun an automated investigation that will eventually extend to all the planets orbiting the Sun, achieved significant increase in our knowledge of Sun-Earth interactions and relationships, and through remote sensing satellites made order of magnitude improvements in how we view the natural and manmade phenomena of the whole Earth, as a first step on the way to better management of all our resources. And we have put astronomy observatories into orbit above the obscuring atmosphere, which are beginning to supply data that may well change our conception of the universe.

Closer to home we have initiated a communications revolution. Though barely begun, the communications satellite program has tied the nations and peoples of our planet together in a way never before possible and it promises the benefits of intercommunity contact to the most remote and isolated areas. We have pioneered the use of high-powered broadcast satellites to bring a variety of public services to communities otherwise without them. And we have developed aeronautical technologies that promise 50 per cent fuel savings for airliners, as well as quieter, more economical, safer and more convenient long and short distance air travel.

In our 20th year, we are deeply involved in solving the primary problems of our time -- through remote sensing helping to locate new sources of fossil fuels while working with the Department of Energy to develop alternate energy resources.

With passenger cars alone burning almost a third of all petroleum products used in this country each year and causing most of the air pollution that blights our metropolitan areas, we are applying our scientific and engineering expertise to improving auto efficiency, economy and environmental acceptability and to developing advanced auto propulsion systems.

Finally, exactly as is true of a man or a woman, the future from the perspective of 20 years is full of challenge, excitement and opportunity. Consider, for example, that the 12 months following our 20th anniversary will see, among other events:

- the launch of the second HEAO to follow up the major astronomical discoveries of its predecessor;
- the arrival of the Pioneer orbiter and probes at Venus;

- the exploration of Jupiter and its moons by both Voyagers; and

- the first orbital test flight of the Shuttle.

Beyond our 21st year, we can see the Shuttle evolving as the major factor in all our operations in space, facilitating and accelerating progress toward nearly all our goals.

The two Vikings, Pioneers 10 and 11, Voyagers 1 and 2, the Galileo mission to Jupiter, the Pioneer investigation of Venus and its atmosphere, will greatly enhance our understanding of the origin, evolution and current nature of the solar system and thus of our own Earth, providing us with an improved ability to preserve, protect and manage it for the benefit of all who live here. Follow-on missions to Mars including the return of a sample of its enigmatic soil, a lunar polar orbiter, a Venus imaging radar orbiter, a Saturn orbiter with Saturn and Titan probes, and comet rendezvous -- all currently under serious study -- have the potential to improve that understanding ability still further.

The Solar-Polar out-of-ecliptic mission, the planned Solar Mesospheric Explorer, and a possible solar probe will add to our knowledge of the Sun-Earth cause and effect relationships of such primary importance to all life on our planet and help us to understand, predict and perhaps eventually to control to some degree the weather processes that affect us in such a basic way.

Man's eon-long efforts to understand the fundamental nature of time, matter and energy will be advanced an order of magnitude in the next decade by a whole new generation of instruments of which the Space Telescope is the centerpiece and key. The contributions of the Space Telescope to our understanding of the physics of the universe are likely to dwarf all but the most fundamental discoveries of the past. Follow-on High Energy Astronomy observatories, ultraviolet, extreme ultraviolet, infrared and gamma ray instruments will complement and supplement the Space Telescope and together bring us measurably closer to an understanding of the nature of the universe and the place of Earth and its inhabitants in relation to it.

As we develop our Earth-sensing capabilitities with Landsat, Seasat, Nimbus, Magsat, GEOS, the Applications Explorer Missions, their follow-on systems and others, we will learn to integrate the data from all such systems into a continuous, accurate, global information system of immense usefulness to all the nations and people of the Earth.

The capability provided by the Shuttle to build large antennas and supporting facilities in space will lead to an enormous advance in the field of space communications that can change society. Such public telecommunications services as electronic mail, medical information delivery, continuing interactive education and broad information access await only positive decisions.

The same Shuttle capability will lead also to new construction techniques which could make the possibility of beamed solar power a reality if and when that concept appears to be economically viable.

There is even a very real, although unquantifiable, possibility in the foreseeable future through our proposed Search for Extraterrestrial Intelligence program, for contact with other intelligent beings in the universe, with the major changes to human society that such contact would bring.

In short, on our 20th anniversary we at NASA can take pride in what we have already accomplished, satisfaction from the knowledge that we are doing useful work on the frontiers of science and technology for the benefit of our people and our country, and exhilaration at the prospects which lie ahead for the continued expansion of human knowledge and the improvement of the condition of mankind on the planet Earth.

Truly a unique new entity has come to exist in the world, an entity of which each one of us can be proud to be a part.

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MAJOR MILESTONES OF NASA PROGRAM

(Background: On Nov., 21, 1957, NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), appointed a special committee on space technology. During the following January, President Eisenhower proposed that the Soviet Union and the U.S. "agree that outer space should be used only for peaceful purposes," a timely suggestion in view of the fact that Russia, with its Sputnik satellite, had taken the lead in the space effort. As that month ended, Explorer 1, America's first satellite, weighing 30 pounds, was launched and led to discovery of the Van Allen radiation belts around the Earth.

Quickly, the Senate and House of Representatives established committees on space and aeronautics. The President proposed establishment of a National Aeronautics and Space Agency, into which NACA would be absorbed, and Congress acted promptly. On July 29, the President signed into law the National Aeronautics and Space Act of 1958.)

1958

Oct. 1-First official day of NASA, with Dr. T. Keith Glennan as Administrator and Dr. Hugh L. Dryden as Deputy Administrator.

Oct. 7-NASA formally approved Project Mercury to send a man into orbit around the Earth, investigate his capabilities and reactions to space and return him safely to Earth.

Oct. 11-The 84-pound PIONEER 1, launched from Cape Canaveral as NASA's first deep space probe, reached an altitude of 70,714 miles.

1959

Feb. 17-VANGUARD 2, NASA's first Earth satellite, launched to demonstrate feasibility of global weather data acquisition.

Mar. 3-World's first six-stage, solid-fuel rocket launched from Wallops Station.

Mar. 10-First captive flight of X-15 rocket airplane.

Apr. 2-Seven astronauts selected for Project Mercury-Captains L. Gordon Cooper, Jr. Virgil I. Grissom and Donald K. Slayton, USAF; Lt. Scott Carpenter, Lt. Cmdrs. Alan B. Shepard, Jr., and Walter M. Schirra, Jr., USN, and Lt. Col. John H. Glenn, USMC.

May 28-Jupiter experiment spacecraft is sent to altitude of 300 miles with monkeys "Able" and "Baker" on board. Primate passengers recovered unharmed.

Aug. 7-EXPLORER 6, placed in an elliptical Earth orbit, returned first crude TV photo of the Earth.

Aug. 17-First of NIKE-ASP sounding rockets to provide geophysical information on wind activity at altitudes of 50 to 150 miles launched from Wallops Station.

Sept. 18-VANGUARD 3, last of series to gather data on the magnetic field, radiation belts and micrometeoroids, launched to end program.

Dec. 14-LITTLE JOE 3, part of the Project Mercury test program, is sent 55 miles into space with a monkey aboard and recovered safely.

1960

Mar. 11-PIONEER 5 launched to measure radiation and magnetic fields between Earth and Venus.

Apr. 1-TIROS 1, first known weather observation satellite, launched and took pictures of Earth's cloud cover from altitude of 450 miles.

July 29-Project Apollo, advanced manned spacecraft program, announced.

Aug. 4-Test Pilot Joseph Walker, in X-15, makes first manned flight at speed of 2,196 mph.

Aug. 12-ECHO 1, first passive communication satellite, reflected a radio message from President Eisenhower across the nation.

Nov. 3-EXPLORER 8, containing instrumentation for detailed measurements of the ionosphere, orbited.

Dec. 9-X-15, with Neil Armstrong as pilot made first flight with ball-shaped "hot nose" reaching an altitude of 50,000 feet and speed of 1,254 mph.

1961

Jan. 1-President Eisenhower issued statement that "the early establishment of a communications satellite system which can be used on a commercial basis is a national objective."

Jan. 30-President Kennedy, newly inaugurated, invited the Soviet Union and other nations to cooperate in invoking "the wonder of science instead of its terrors," especially in developing a weather prediction program.

Jan. 30-James E. Webb nominated as NASA Administrator by President Kennedy to succeed Dr. T. Keith Glennan, retired.

Mar. 10-NASA announced first success in immediate detection real time of radar signals off planet Venus.

Apr. 14-NASA informed House Science and Astronautics Committee it will take $20 to $40 billion to achieve a lunar landing.

May 5-FREEDOM 7, manned Mercury spacecraft carring Astronaut Alan B. Shepard, Jr., as pilot, launched at Cape Canaveral as first American manned space flight. Flight lasted 14.8 minutes and reached an altitude of 115 miles.

May 19-Cape Canaveral opened to general public for first time in its history.

May 25-President Kennedy called for speedup in American space effort and declared a national space goal of "landing an American on the Moon in this decade."

July 21- Mercury Astronaut Virgil I. Grissom made a 15-minute, 118-mile-high and 303-mile long flight in LIBERTY BELL 7, second successful manned suborbital flight.

Dec. 7-Plans for the development of a two-man Mercury capsule were announced.

1962

Feb. 20-Mercury spacecraft FRIENDSHIP 7, with Lt. Col. John H. Glenn, Jr. as astronaut, launched on first U.S. manned orbital space flight, covering 81,000 miles in 4 hours and 56 minutes.

Mar. 7-OSO-1 (Orbiting Solar Observatory), NASA's first scientific observatory spacecraft, successfully launched to study the Sun.

Apr. 26-ARIEL-1, first international satellite, carrying 6 British experiments, launched from Cape Canaveral.

May 24-AURORA 7, with Astronaut M. Scott Carpenter as pilot, launched on orbital mission from Cape Canaveral on the second U.S. manned orbital and fourth U.S. manned space flight, was recovered after three orbits. Mission lasted nearly 5 hours.

June 8-NASA and Soviet Academy of Science agreed on coordinated projects in satellite meteorology, communications and magnetic survey.

July 10-TELSTAR 1, first privately-financed satellite, put into orbit.

July 23-TELSTAR relayed two 20-minute live TV shows, first formal exchange of programs across the Atlantic.

Aug. 27-Mariner 2 launched from Cape Canaveral on 180-million mile, four-month flight to Venus, later transmitting first data from that planet's vicinity.

Aug. 21-President Kennedy signed into law the communications satellite bill to establish a private corporation to be in charge of the U.S. portion of future global communications satellite network.

Sept. 17-Nine more astronauts named at Houston--Neil A. Armstrong and Eliot M. See, Jr., civilian test pilots; Maj. Frank Borman, Capt. James A. McDivitt, Capt. Thomas P. Stafford and Capt. Edward H. White II, all of the USAF, and Lt. Charles Conrad, Jr., Lt. Comdr. James A. Lovell, Jr., and Lt. Comdr. John W. Young, all of the USN.

Oct. 3-SIGMA 7 spacecraft, with Astronaut Walter M. Schirra, Jr., as pilot, launched from Cape Canaveral to travel 160,000 miles and make nearly six orbits in 9 hours and 14 minutes.

Oct. 18-RANGER 5 lunar probe launched.

Oct. 25-First live two-way radio broadcast conducted via TELESTAR.

1963

Mar. 19-Goddard Space Flight Center, in cooperation with NBC and RCA, accomplished first known transmission of television in color via RELAY communications satellite.

Apr. 11-X-15 flew at speed of 2,500 mph and altitude of 70,000 feet in its first test as an aerial mapping plane.

May 7-TELSTAR 2 communications satellite placed in elliptical orbit.

May 15-Mercury spacecraft FAITH 7, with Astronaut Gordon Cooper as pilot, made successful orbital flight, the longest U.S. manned mission to date, making 22 orbits in 34 hours and 20 minutes.

June 12-Project Mercury officially ended, having achieved its goals.

July 26-SYNCOM 2 communications satellite put in orbit, providing telephone, teletype and photo facsimile communications between U.S. and Africa.

Sept. 2-Two flight tests of M-2 wingless lifting body conducted by Flight Research Center.

Nov. 23-First live transmission of television signals across the Pacific Ocean accomplished by RELAY 1.

1964

Jan. 25-ECHO 2 passive communications satellite, used in the first joint US/USSR space experiment, placed in near-polar orbit.

Mar. 25-First TV transmission from Japan to the U.S. made via RELAY 2 communications satellite.

Apr. 8-Unmanned Gemini spacecraft launched into orbit in first Project Gemini Flight.

July 14-MARINER 4 launched on 228-day, 325-million-mile flight to Mars, sending back first close photos of that planet.

July 20-Spaceflight of SERT 1 spacecraft marked first successful operation in space of an electric rocket engine.

July 28-RANGER 7 spacecraft launched from Cape Kennedy on its way to the Moon, sending back 4,316 clear photos before it impacted on lunar surface.

Sept. 4-OGO 1 satellite, designed to perform 20 space experiments at once, placed in orbit.

1965

Feb. 17-RANGER 8 spacecraft, equipped with six television cameras to photograph part of the Moon's surface,launched.

Mar. 23-GEMINI 3 spacecraft, with Astronauts Virgil I. Grissom and John W. Young on board, launched and made three orbits in 4 hours and 53 minutes, during which a manned spacecraft was maneuvered in orbit for first time.

Mar. 24-After transmitting 5,814 close-up lunar pictures to Earth, RANGER 9 was impacted on Moon.

Apr. 6-INTELSAT 1, first commercial communications satellite, placed in synchronous equatorial orbit above Atlantic Ocean.

May 30-A modified Convair 990A jet transport, NASA's new high-altitude research laboratory, carried 30 scientists from five countries and a million dollars' worth of delicate instruments in a race with a total eclipse over the South Pacific.

June 3-GEMINI 4 spacecraft, with Astronauts James A. McDivitt and Edward H. White as pilots, launched to make 62 revolutions around the Earth in 97 hours and 56 minutes, during which White became the first American to walk in space.

July 14-MARINER 4, launched the preceding Nov. 28, approached within 5,500 miles of Mars and took the first close-up pictures of that planet.

Aug. 21-GEMINI 5, piloted by Astronauts L. Gordon Cooper and Charles Conrad, Jr. launched on eight-day mission, lasting 190 hours and 56 minutes, during which 120 revolutions of the Earth were made.

Nov. 6-EXPLORER 29 geodetic satellite launched from Eastern Test Range by an Improved Thrust-Augmented Delta in first use of a gravity-gradient system for stabilization.

Dec. 4-GEMINI 7, piloted by Astronauts Frank Borman and James A. Lovell, Jr., launched on 14-day mission. Eleven days after launch, the spacecraft achieved its historic rendezvous in orbit with GEMINI 6, launched Dec. 15 and piloted by Astronauts Walter Schirra, Jr., and Thomas P. Stafford.

1966

Mar. 16- Astronauts Neil Armstrong and David R. Scott, in GEMINI 8, performed world's second rendezvous and first docking experiment with an unmanned Gemini Agena Target Vehicle (GATV). Mission lasted 10 hours and 42 minutes.

Apr. 29-One of world's largest and most sensitive automatic space tracking and telemetry antennas was officially dedicated at Goldstone, Calif.

May 19-X-B-70A operational aircraft successfully made sustained 2,000-mph flight at 70,000-foot altitude for 32 minutes.

May 30-SURVEYOR 1 launched to become first U.S. spacecraft to softland on Moon when it touched down in the Ocean of Storms and began sending back pictures.

June 3-GEMINI 9, with Astronauts Thomas P. Stafford and Eugene A. Cernan as pilots, launched on three-day flight to overtake Augmented Target Docking Adapter, during which Cernan performed a spacewalk of more than two hours, longest to date.

July 18-GEMINI 10, eighth manned flight in Gemini series, launched on successful rendezvous and docking mission to overtake GATV. Astronauts John W. Young and Michael Collins were pilots and performed first docked-spacecraft maneuver, also rendezvousing with Gemini 8's GATV target.

Aug. 10-LUNAR ORBITER 1, unmanned, launched to become first U.S. spacecraft to enter lunar orbit, taking first pictures of Earth from vicinity of Moon. Orbiter intentionally crashed into far side of Moon.

Sept. 12-Three-day GEMINI 11 mission, with Astronauts Charles Conrad, Jr., and Richard F. Gordon, Jr., as pilots became first spacecraft to achieve first-revolution rendezvous and docking with GATV, using tether to link two spacecraft.

Nov. 11-GEMINI 12, last of the series, launched with Astronauts James A. Lovell, Jr., and Edwin A. Aldrin, Jr., on board. Aldrin performed two standup EVAs. Mission lasted nearly four days.

1967

Jan. 27-Three-man crew training for first Apollo flight--Virgil I. Grissom, Edward H. White II and Roger B. Chaffee -- died when flash fire swept through Command Module at KSC.

Jan. 27-Representatives of 62 nations signed the United Nations treaty on the exploration and use of outer space.

Apr. 17-SURVEYOR 3 launched on mission to Moon to land in Ocean of Storms and excavate with surface sampler trenches up to six inches deep.

June 14-MARINER 5 spacecraft launched on four-month, 212-million-mile flyby mission to Venus.

Sept. 8-SURVEYOR 5 softlands on Moon to take photographs of possible landing sites for Apollo spacecraft and begins on-site chemical analysis of an extraterrestrial body.

Nov. 9-APOLLO 4 spacecraft was successfully sent aloft in first Saturn V flight and first launch from Complex 39 at Kennedy Space Center, making first all-up test of three-stage launch vehicle and reentering at lunar-return velocity.

1968

Jan. 7-SURVEYOR 7 launched to softland in Moon's highlands, return TV pictures, perform lunar-digging experiments and detect laser beams directed from Earth.

Jan. 22-APOLLO 5 launched from KSC on unmanned Earth orbital mission to verigy operation of Lunar Module ascent and descent propulsion system. Adjudged successful.

Apr. 4-APOLLO 6 was successfully launched on mission to qualify Saturn V launch vehicle, demonstrating rocket and spacecraft subsystem and heat shield performance.

Oct. 6-Administrator James E. Webb retired and was succeeded by Dr. Thomas O. Paine, formerly Deputy Administrator.

Oct. 11-APOLLO 7, first manned CSM operation in Apollo lunar landing program, successfully launched from KSC with Astronauts Walter M. Schirra, Jr., Donn F. Eisele and R. Walter Cunningham. Crew appeared on TV in initial telecast from space. Mission lasted 10 days, 20 hours, accomplishing rendezvous with S-IVB stage. Earth circled 168 times.

Dec. 21-APOLLO 8, second manned mission in program and first to orbit Moon, launched. Astronauts: Frank Borman, James A. Lovell and William Anders. Mission duration 6 days, 3 hours. Twenty hours in lunar orbit. Circled Moon 10 times. Support facilities tested. Photographs taken of Earth and Moon. Live TV broadcasts.

1969

Feb. 9-NASA announced supercritical wing, a new airfoil shape developed in four years of wind-tunnel studies at Flight Research Center, will be flight tested.

Mar. 3-APOLLO 9, first manned flight of all lunar hardware in Earth orbit, launched. Astronauts: James A. McDivitt, David R. Scott and Russell L. Schweickart. Mission duration 10 days, 1 hour. Schweickart performed 37-minute EVA. Human reactions to space and weightlessness tested in 152 orbits. First manned flight Lunar Module (LM).

May 18-APOLLO 10 launched for dress rehearsal of Moon landing. Astronauts: Eugene A. Cernan, John W. Young and Thomas P. Stafford. Mission duration 8 days, 3 minutes. First manned CSM/LM operations in cislunar and lunar environment; simulation of first lunar landing profile. In lunar orbit 61.6 hours, with 31 orbits. LM taken to within 47,000 feet of lunar surface. First live color TV from space. LM ascent stage jettisoned in orbit.

July 16-APOLLO 11 launched on first lunar landing mission and lunar surface EVA. Astronauts: Neil A. Armstrong, Michael Collins and Edwin E. Aldrin, Jr. Landed on Sea of Tranquility. One EVA --2 hours, 31 minutes. Mission duration 8 days, 3 hours, 18 minutes. Armstrong and Aldrin landed on Moon July 20. Flag and instruments deployed. Lunar surface stay time 21.6 hours; 59.5 hours in lunar orbit, with 30 orbits. LM ascent stage left in lunar orbit. President Nixon made first long distance phone call to Moon to congratulate astronauts. The mission achieved the goal set on May 25, 1961 by President Kennedy of landing an American on the Moon within the decade.

July 29-First pictures of Mars, taken by MARINER 6, received at JPL.

Sept. 12-NASA began distributing lunar material from the APOLLO 11 mission to scientific investigators in the U.S. and 8 other countries.

Nov. 14-APOLLO 12, second manned lunar landing mission launched. Astronauts: Charles Conrad, Jr., Richard E. Gordon, Jr., and Alan L. Bean. Landed on Ocean of Storms. First demonstration of pinpoint landing capability. Candidate landing sites photographed. Parts taken from SURVEYOR 2, unmanned spacecraft went to Moon in April 1967. Lunar stay time 32.5 hours. LM ascent stage impacted on Moon.

1970

Mar. 31-EXPLORER 1, first U.S. satellite, launched Jan. 31, 1958, reentered Earth atmosphere after completing 58,408 revolutions and traveling 2.67 billion miles.

Apr. 11-APOLLO 13, third lunar landing mission attempt, launched. Astronauts: James A. Lovell, John L. Swigert, Jr., and Fred W. Haise, Jr. Mission duration 5 days, 22.9 hours. Mission aborted after rupture of Service Module oxygen tank. Classed as "successful failure" because of experience in rescuing crew. Spent S-IVB stage successfully impacted on Moon.

Sept. 15-Dr. Thomas O. Paine resigned as NASA Administrator. Dr. George M. Low, Deputy Administrator, serves as Acting Administrator.

Dec. 12-EXPLORER 42 launched into equatorial orbit from the San Marco platform off the coast of Kenya by an Italian crew, the first American spacecraft to be sent aloft by men of another country.

1971

Jan. 31-APOLLO 14, third lunar landing mission, launched. Astronauts: Alan B. Shepard, Jr., Stuart A. Roosa and Edgar D. Mitchell. Landed on Frau Mauro, rocky upland area. Docking and other difficulties experienced demonstrated value manned flight over unmanned flight Lunar surface stay time 33.5 hours, 67 hours in lunar orbit, with 34 orbits. Third stage impacted on Moon, using hand cart for first time to transport rocks.

Apr. 27-Dr. James C. Fletcher is sworn in as NASA Acministrator to succeed Dr. Paine.

July 26-APOLLO 15, fourth lunar landing mission and first of "J" series using Lunar Roving Vehicle (LRV), launched.

July 26-APOLLO 15, fourth lunar landing mission and first of "J" series using Lunar Roving Vehicle (LRV), launched. Astronauts: David R. Scott, James B. Irvin and Alfred M. Worden. Landed in Hadley-Apennine region near Apennine Mountains. First to carry orbital sensors in Service Module. ALSEP deployed. Improved spacesuits gave increased mobility and stay time. Scientific payload landed on Moon doubled. Lunar surface stay time 66.9 hours. LRV traversed total of 27.9 km. Small subsatellite left in lunar orbit for first time.

Sept. 29-OSO-7 launched to make first X-ray observations of a beginning solar flare and of solar "streamers".

Nov. 13-MARINER 9, Launched May 30, went into orbit of Mars, first to circle another planet and took first close photos of Mars' moons Deimos and Phobos and of a Mars dust storm.

1972

Jan. 5-President Nixon announced decision that U.S. should develop Space Shuttle system.

Mar. 2-PIONEER 10 Jupiter probe launched to become first man-made object to escape solar system, first spacecraft to use orbital velocity and gravity of Jupiter for escape, and first NASA spacecraft powered entirely by nuclear energy.

Apr. 16-APOLLO 16, fifth lunar landing mission, launched. Astronauts: John W. Young, Thomas K. Mattingly II and Charles M. Duke, Jr. Landed in Descartes, highlands area. First study of highlands area. Ultraviolet camera/spectrograph used second time. Lunar surface stay time 71 hours. LRV traversed total of 27 km.

May 24-President Nixon and USSR Premier Kosygin in Moscow signed an agreement providing for cooperation in the exploration of outer space for peaceful purposes and the docking in space in 1975 of a U.S. and a Soviet spacecraft.

May 26-NASA announced retirement of Dr. Wernher von Braun, Deputy Associate Administrator for Planning and a pioneer in the space effort, effective July 1.

July 23-ERTS 1 launched to acquire information for investigations in agriculture, forestry, minerals, etc.

Dec. 7-APOLLO 17, sixth lunar landing and final mission in Apollo series, launched. Astronauts: Eugene A. Cernan, Ronald B. Evans and Harrison H. Schmitt, the last named the first geologist on the Moon. Landed in Taurus-Littrow area, valley floor; lunar surface stay time 74 hours, 59 minutes, 38 seconds. LRV traversed 35 km.

1973

May 14-SKYLAB 1, the nation's first orbiting laboratory, was launched from Cape Kennedy, with a three-man crew, Charles Conrad, Jr. Joseph P. Kerwin and Paul J. Weitz, scheduled to rendezvous with it the next day. Twelve minutes after launch, signals revealed the meteoroid shield had been torn away and one of two solar panels only partially deployed. The spacecraft was maneuvered to keep its interior from becoming too hot and centers were alerted to start searching for a solution to the emergency.

May 25-After 11 days during which technicians worked around the clock to develop a parasol as a substitute for the heat shield and tools with which astronauts could cut the metal strap found to be keeping the solar wing from deploying, the crew was launched and rendezvoused with SKYLAB. Next day, the parasol was deployed and, on June 7, an EVA to free the solar array was performed. A 28-day mission was completed on June 22.

July 28-The second SKYLAB crew, Alan L. Bean, Jack R. Lousma and Owen K. Garriott, was launched. Enroute, a rocket thruster on the spaceship conveying them aloft began leaking. On August 2, a second thruster developed leaks, leaving only two in operable condition. A rescue ship was readied at Cape Kennedy, but officials decided to allow the astronauts to complete a 59-day mission and return to Earth via their disabled craft on September 25.

Nov. 3-MARINER 10 launched to conduct exploratory investigations of Mercury and later Venus during its flyby.

Nov. 16-Skylab 3 lifts off with a crew of Gerald Carr, Edward Gibson and William Pogue; the final Skylab mission had begun.

1974

Feb. 8-SKYLAB 3 splashes down in the Pacific Ocean after 84 days, 1 hour and 16 minutes in space, setting a new mark for time spent in space by American astronauts.

Dec. 2-PIONEER 11, launched April 6, 1973, hurtles past Jupiter sending back information and pictures from the solar system's largest planet.

Dec. 10-HELIOS-A is launched to investigate the properties of space in the direction of and close to the Sun.

Dec. 15-NASA announces that PIONEER 11 will fly by Saturn to study the planet's rings. The probe will reach Saturn in September 1979.

1975

Jan. 22-LANDSAT 2 (formerly ERTS) is launched to locate, map and measure Earth resources from space.

April 9-GEOS 3 is sent into orbit around the Earth to measure ocean topography, sea state and other features of the Earth.

June 15-The final Apollo spacecraft is launched to link up in space with the Soviet Soyuz vehicle. On board the Apollo are: Tom Stafford, Vance Brand and Donald "Deke" Slayton. On July 24, the Apollo spacecraft safely returned to Earth.

Aug. 20-The United States' first attempt to softland a spacecraft on another planet begins with the launch of VIKING 1 and a sister ship, VIKING 2 is launched on Sept. 9.

1976

Feb. 10-PIONEER 10 crosses the rings of Saturn and continues out towards Pluto which it will reach in 1987.

July 20-VIKING 1 lands on Mars and begins relaying first analysis of surface material on another planet.

Sept. 3-VIKING 2 lands on Mars and starts returning scientific data to Earth.

Dec. 30-For the second time in its history, NASA had a perfect launch record, successful in all 16 of its launches. In 1972, NASA also had a perfect record, launching 18 satellites.

1977

Mar. 14-Dr. James C. Fletcher submits his resignation as Administrator of NASA May 1.

May 24-President Carter mominates Dr. Robert A. Frosch as Administrator of NASA.

Aug. 12-The first approach and landing test free flight of the Space Shuttle is made with astronauts Fred Haise and Gordon Fullerton onboard

Aug.12-HEAO-1 (High Energy Astronomy Observatory) is launched to study and map X-rays and gamma rays.

Aug. 20-VOYAGER 2 is launched to study Jupiter and Saturn Planetary systems including their satellites and Saturn's rings.

Sept. 5-VOYAGER 1 is launched to investigate Jupiter and Saturn planetary systems.

Oct. 22-ISEE 1&2 are launched. The International Sun-Earth Explorer is a joint NASA/European Space Agency mission to study the interaction of the interplanetary medium with Earth's immediate environment.

Oct. 26-Haise and Fullerton pilot and land the Space Shuttle for the fifth and final free flight in the Shuttle approach and landing tests.

1978

Jan. 16-NASA selects 35 new astronaut candidates to undergo two years of training in Houston in preparation for Space Shuttle flight in the 1980s. For the first time, the group included six women and four minorities. NASA received 8,079 applications in the year-long recruiting period before selection.

Mar. 5-LANDSAT 3, an ecological data satellite, is sent into orbit around the Earth.

March 17-NASA announces four crews for early flights of the Space Shuttle. Those named are: John Young, Robert Crippen, Joe Engle, Richard Truly, Fred Haise, Jack Lousma, Vance Brand and Charles Fullerton.

May 20-PIONEER-VENUS 1 launched from the Kennedy Space Center. The spacecraft will orbit Venus and study the planet's atmosphere and surface.

June 1-Five scientists are selected to serve as payload specialists during the first Spacelab mission scheduled for the latter part of 1980.

June 26-The first ocean-monitoring satellite, SEASAT 1, is launched.

Aug. 8- PIONEER-VENUS 2 is launched. The multiprobe spacecraft will reach Venus some four months later.

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NASA CENTERS SPAN U. S.

Since the National Aeronautics and Space Administration was established in October 1958, its network of centers and facilities has spread across the United States.

Here is a brief outline of NASA Headquarters and the centers and facilities, with information of their programs and responsibilities.

NASA HEADQUARTERS
Washington, D. C.

Headquarters manages the space flight centers, research centers and other NASA installations. Planning, direction and management of NASA's research and development programs are the responsibility of individual program offices which report to, and are directed by Headquarters officials.

Headquarters responsibilities include the determination of projects and programs, establishment of management policies, procedures and performance criteria and review and analysis of all phases of the aerospace program.

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AMES RESEARCH CENTER
Mountain View, Calif.

Ames has a number of specialized facilities for research in spacecraft technology and the aeronautical, physical, space and life sciences. These include wind tunnels covering the speed range from subsonic to hypersonic, motion based flight simulators, advanced digital computation systems and a variety of well-equipped ground based and airborne laboratories.

Programs at Ames range from short and vertical takeoff and landing technology (STOL and VSTOL) to management responsibility for the Pioneer planetary spacecraft and support of the Space Shuttle program by providing research on heat protection and flight controls.

DRYDEN FLIGHT RESEARCH CENTER
Edwards, Calif.

Dryden, located on the Mojave Desert, is at the southern end of a 500-mile high-speed flight corridor and has almost ideal weather for flight testing. Ground facilities include a high-temperature loads calibration laboratory, a unique national facility that provides for ground-based testing of complete aircraft and structural components under the combined effects of load and heat and a flight systems laboratory for avionics system fabrication, development and operation.

Most recently, the center was the site of the Approach and Landing Tests of the Space Shuttle Orbiter and the first orbital flights will return from space and land there. The center's efforts have dealt with such unusual flight vehicles as the Lunar Landing Research Vehicle, wingless lifting bodies and the remotely piloted research vehicle.

GODDARD SPACE FLIGHT CENTER
Greenbelt, Md.

Goddard has a leading group of scientists, engineers and administrative managers doing research in space/Earth sciences and applications.

Satellite and sounding rocket projects at Goddard provide data about the Earth's environment, Sun/Earth relationships and the universe, advancing technology in such areas as communications, meteorology, navigation and the detection and monitoring of our natural resources.

Goddard is the home of the National Space Science Data Center, the central repository of data collected from space flight experiments. Much of the center's theoretical research is conducted at the Goddard Institute for Space Studies in New York City.

JET PROPULSION LABORATORY
Pasadena, Calif.

The Jet Propulsion Laboratory (JPL) is a government-owned facility that is staffed and managed by the California Institute of Technology under a NASA contract. JPL also operates the Deep Space Communication Complex at Goldstone, Calif.

JPL is engaged in deep space automated scientific missions, tracking, data acquisition, data reduction and analysis required by deep space flight, advanced solid propellant and liquid propellant spacecraft engines, advanced spacecraft guidance and control systems and integration of advanced propulsion systems into spacecraft. Programs under its management include Mariner and Voyager.

JOHNSON SPACE CENTER
Houston, Texas

The Lyndon B. Johnson Space Center (JSC) is responsible for design, development and testing of the nation's manned flight vehicles, for selection and training of space flight crews, for ground control of manned flights and many of the medical, engineering and scientific experiments carried aboard the flights.

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JSC is the lead NASA center in management of the Space Shuttle program and one of the center's best known facilities is the Mission Control Center from which manned flights starting with Gemini IV, through the Apollo and Skylab series and the US/USSR Apollo Soyuz Test Project were controlled.

KENNEDY SPACE CENTER
Kennedy Space Center, Fla.

Kennedy Space Center (KSC) is NASA's primary center for the test, checkout and launch of space vehicles and will be the primary launch and recovery site for the Space Shuttle.

The center was created to launch the Apollo lunar landing missions and was also used for the Skylab series and the Apollo Soyuz Test Project. KSC also launches a variety of unmanned missions from facilities at Cape Canaveral Air Force Station and Vandenberg Air Force Base (Western Test Range), Calif.

LANGLEY RESEARCH CENTER
Hampton, Va.

A large part of Langley's research work centers on development of advanced concepts and technology for future aircraft, with emphasis on environmental effects, performance, range, safety and economy. This covers such projects as the supercritical wing, composite structural materials and automatic flight control systems.

The center was responsible for the Viking Mars lander project and supports manned and unmanned space programs through experiments, sensors, communications equipment and data handling systems.

LEWIS RESEARCH CENTER
Cleveland, Ohio

Lewis activities are aimed at advancing technologies for aircraft propulsion, propulsion and power generation for space flight, space communications systems and new terrestrial energy systems.

The center manages two major launch vehicles, the Atlas Centaur and the Titan Centaur and specialized experimental facilities include a zero-gravity drop tower, chemical-rocket static thrust stands and chambers for testing jet engine efficiency and noise.

MARSHALL SPACE FLIGHT CENTER
Huntsville, Ala.

About half of Marshall's current effort is in the Space Shuttle program. The center is responsible for work on associated upper stages, payloads, payload carriers, payload mission planning and operations, future space systems, and supporting research and technology, the Shuttle Main Engine, External Tank, Solid Rocket Booster, propulsion system testing and structural and dynamic testing of Shuttle components.

The center also directs operations at the Michoud Assembly Facility in Orleans Parish, La., and the Slidell Computer Complex, Slidell, La.

NATIONAL SPACE TECHNOLOGY LABORATORIES
NSTL Station, Miss.

The current mission of NSTL, formerly the Mississippi Test Facility, is support of the Space Shuttle Main Engine and main orbiter propulsion system testing. It has also been assigned a mission to conduct a regional Earth resources training program for the 17 southeast or "Sun Belt" states, from North Carolina to New Mexico.

WALLOPS FLIGHT CENTER
Wallops Island, Va.

Wallops prepares, assembles, launches and tracks space vehicles. Research at the center is directed toward gathering information about the Earth's atmosphere and its near space environment.

Facilities at the center are used for a number of other research projects such as space component tests, helicopter and aircraft drop tests, helicopter and aircraft noise projects, anti-skid tests on grooved runways, collision avoidance programs and laser and radar tracking of aircraft and satellites.

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NASA MAJOR LAUNCH RECORD

NOTE: All launches are from the Eastern Test Range unless otherwise noted. Symbols for launch areas and other items are as follows:

WI: Wallops Island (Va.)
WSMR: White Sands Missile Range (N.M.)
WTR: Western Test Range (Calif.)

L: Launch
D: Down
L/V: Launch Vehicle

Mission	Vehicle	Date	Mission/Remarks
Pioneer I	Thor Able 1	L: 10/11/58 D: 10/12/58	Particles and Fields: Failed to reach Moon; sent 43 hours of data.
Beacon 1	Jupiter C	L: 10/23/58 D: 10/23/58	Atmospheric Physics: 12-foot sphere; upper stages separated prior to burnout.
Pioneer II	Thor Able 1	L: 11/8/58 D: 11/8/58	Scientific Lunar Probe: Third stage failure; reached 963 miles; its brief data indicated equatorial region had higher flux and energy levels than previously thought.
Pioneer III	Juno II	L: 12/6/58 D: 12/7/58	Energetic Particles: Discovered second radiation belt. Failed to reach Moon.
		1959	
Vanguard II	Vanguard (SLV-4)	L: 2/17/59	Meteorology: Precession of satellite prevented usable cloud cover data. First Earth photo from satellite.
Pioneer IV	Juno II	L: 3/3/59	Cislunar and Lunar Probe: Energetic particles, passed 37,300 miles from the Moon March 4, 1959.
Vanguard	Vanguard (SLV-5)	L: 4/13/59 D: 4/13/59	Magnetic Fields and Atmospheric Physics: 30-inch sphere; second stage failure.

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Mission	Vehicle	Date	Mission/Remarks
Vanguard	Vanguard (SLV-6)	L: 6/22/59 D: 6/22/59	Solar-Earth Heating: Second stage failure.
Explorer (S-1)	Juno II	L: 7/16/59 D: 7/16/59	Energetic Particles: Destroyed after 5 1/2 seconds by range safety officer.
Explorer VI (S-2)	Thor Able	L: 8/7/59 D: Prior to July 1961	Particles and Meteorology: Three radiation levels; crude cloud cover image; ring of electric current circling Earth.
Beacon II	Juno II	L: 8/14/59 D: 8/14/59	Atmospheric Physics: 12-foot sphere; premature fuel depletion in first stage; upper stage malfunction.
Big Joe (Mercury)	Atlas	L: 9/9/59 D: 9/9/59	Suborbital Mercury Capsule Test: Capsule successfully recovered after reentry test.
Vanguard III	Vanguard (SLV-7)	L: 9/18/59	Particles and Fields: Magnetic field survey, lower edge of radiation belt. Last transmission Dec. 8, 1959.
Little Joe 1	Little Joe (L/V #6)	L: 10/4/59 D: 10/4/59	Suborbital Mercury Capsule Test: Qualified booster for use with Mercury test program. (WI)
Explorer VII	Juno II (19A)	L: 10/13/59	Energetic Particles: Data on radiation and magnetic storms; first micrometeorite penetration of sensor.
Little Joe 2	Little Joe (L/V #1A)	L: 11/4/59 D: 11/4/59	Suborbital Mercury Capsule Test: Capsule escape test. Escape rocket had a delayed thrust buildup. (WI)
Pioneer (P-3)	Atlas Able	L: 11/26/59 D: 11/26/59	Lunar Orbiter: Shroud failure after 45 seconds.

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Mission	Vehicle	Date	Mission/Remarks
Little Joe 3	Little Joe (L/V #2)	L: 12/4/59 D: 12/4/59	Suborbital Mercury Capsule Test: Escape system and biomedical tests; Monkey (Sam). (WI)
		1960	
Little Joe 4	Little Joe (L/V #1B)	L: 1/21/60 D: 1/21/60	Suborbital Mercury Capsule Test: Escape system and biomedical test; Monkey (Miss Sam) aboard. (WI)
Pioneer V (P-2)	Thor Able IV	L: 3/11/60	Particles and Fields: Ciscytherean space; first solar flare data; solar wind.
Explorer (S-46)	Juno II	L: 3/23/60 D: 3/23/60	Energetic Particles: Failure in upper stages.
Tiros I	Thor Able	L: 4/1/60	Meteorology: First global cloud cover pictures. Last transmission 6/17/60.
Scout X	Scout X	L: 4/18/60 D: 4/18/60	Launch Vehicle Development Test: Structural failure prevented third stage ignition (dummy second and fourth stages). (WI)
Echo A-10	Thor Delta	L: 5/13/60 D: 5/13/60	Communications Earth Satellite: Failure in upper stages of vehicle.
Scout I	Scout	L: 7/1/60 D: 7/1/60	Launch Vehicle Development Test. (WI)
Mercury (MA-1)	Atlas	L: 7/29/60 D: 7/29/60	Suborbital Mercury Capsule Reentry Test: Atlas exploded.
Echo I (A-11)	Thor Delta	L: 8/12/60 D: 5/24/68	Communications Earth Satellite: First passive communications satellite. 100-foot sphere used for passive communications and air density experiments.
Pioneer (P-30)	Atlas Able	L: 9/25/60 D: 9/25/60	Scientific Lunar Orbiter: Second stage failure.

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Mission	Vehicle	Date	Mission/Remarks
Scout II	Scout	L: 10/4/60 D: 10/4/60	Launch Vehicle Development Test: Air Force Special Weapons Center radiation experiment payload included. (WI)
Explorer VIII	Juno II	L: 11/3/60	Ionosphere: Confirmed existence of helium layer in upper atmosphere. Last transmission Dec. 28, 1960.
Little Joe 5	Little Joe (L/V #5)	L: 11/8/60 D: 11/8/60	Suborbital Mercury Capsule Test. Mercury capsule system qualification; premature escape rocket firing. (WI)
Tiros II	Thor Delta	L: 11/23/60	Meteorology: Optical and infrared photos of global cloud cover.
Explorer	Scout	L: 12/4/60 D: 12/4/60	Atmospheric Physics/ Vehicle Test: 12-foot sphere; second stage failure. (WI)
Pioneer (P-31)	Atlas Able	L: 12/15/60 D: 12/15/60	Scientific Lunar Orbiter: Exploded after 74 seconds.
Mercury (MR-1A)	Redstone	L: 12/19/60 D: 12/19/60	Suborbital Mercury Capsule Test: Unmanned 235-mile flight. Successful.
		1961	
Mercury (MR-2)	Redstone	L: 1/31/61 D: 1/31/61	Suborbital Mercury Capsule Test: 16-minute flight of chimpanzee (Ham).
Explorer IX	Scout	L: 2/16/61 D: 4/9/64	Atmospheric Physics/ Vehicle Test: 12-foot sphere. (WI)
Mercury (MA-2)	Atlas	L: 2/21/61 D: 2/21/61	Suborbital Mercury Capsule Test: Unmanned; 1425-mile flight; successful.
Explorer	Juno II	L: 2/24/61 D: 2/24/61	Ionosphere: Second stage malfunction prevented third and fourth stage firing.

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Mission	Vehicle	Date	Mission/Remarks
Little Joe 5A	Little Joe (L/V #5A)	L: 3/18/61 D: 3/18/61	Suborbital Mercury Capsule Test: Mercury escape system qualification; premature escape-rocket firing. (WI)
Mercury (MR-BD)	Redstone	L: 3/24/61 D: 3/24/61	Vehicle Test for Mercury Flight: Booster development test necessitated by MR-2 flight results.
Explorer X	Thor Delta	L: 3/25/61 D: 6/68	Particles and Fields: Interplanetary magnetic field near Earth, mainly extension of Sun's magnetic field.
Mercury (MA-3)	Atlas	L: 4/25/61 D: 4/25/61	Orbital Mercury Capsule Test: Failure in first stage; abort successful.
Explorer XI	Juno II (4 stages)	L: 4/27/61	Gamma Ray Astronomy: Eliminated simultaneous matter-antimatter creation theory of the steady-state cosmology. Last transmission 12/7/61.
Little Joe 5B	Little Joe (L/V #5B)	L: 4/28/61 D: 4/28/61	Suborbital Mercury Capsule Test: One booster engine fired late. Repeat of Mercury escape system test(WI).
Mercury (Freedom 7)	Redstone (MR-3)	L: 5/5/61 D: 5/5/61	Manned suborbital: Alan B. Shepard, Jr. 15 minutes flight time.
Explorer	Juno II	L: 5/24/61 D: 5/24/61	Ionosphere: Second stage failure.
Meteoroid Satellite A	Scout	L: 6/30/61 D: 6/30/61	Micrometeoroids/Vehicle Test: Third stage failure. (WI)
Tiros III	Thor Delta	L: 7/12/61	Meteorology: Good cloud cover picture, infrared data. Last transmission 2/27/62.
Mercury (Liberty Bell 7)	Redstone (MR-4)	L: 7/21/61 D: 7/21/61	Manned suborbital: Virgil I. Grissom. 16 minutes flight time.

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Mission	Vehicle	Date	Mission/Remarks
Explorer XII	Thor Delta	L: 8/16/61 D: 9/63	Particles and Fields: Identified Van Allen Belt as a magnetosphere.
Ranger I	Atlas Agena	L: 8/23/61 D: 8/30/61	Particles and Fields: Lower Earth orbit than planned.
Explorer XIII	Scout	L: 8/25/61 D: 8/28/61	Micrometeoroids/Vehicle Test: Premature reentry after three days. (WI)
Mercury (MA-4)	Atlas	L: 9/13/61 D: 9/13/61	To orbit the unmanned Mercury capsule to test systems and ability to return capsule to predetermined recovery area after one orbit. All capsule tracking and recovery objectives met.
Probe A (P-21)	Scout	L: 10/19/61 D: 10/19/61	Scientific Geoprobe/Vehicle Test: Reached 4261 miles. Electron density measurement; vehicle test. (WI)
Saturn Test (SA-1)	Saturn I	L: 10/27/61 D: 10/27/61	Launch Vehicle Development: Test of propulsion system of the booster (S-1); verification of aerodynamic and structural design of entire vehicle.
Mercury (MS-1)	AF 609A (Blue Scout)	L: 11/1/61 D: 11/1/61	Orbital Mercury Network Check: Destroyed after 30 seconds; Air Force launched.
Ranger II	Atlas Agena	L: 11/18/61 D: 11/20/61	Particles and Fields: Agena failed to restart.
Mercury (MA-5)	Atlas	L: 11/29/61 D: 11/29/61	Mercury Orbital Flight: Chimpanzee Enos aboard. Recovered after two orbits.

Mission	Vehicle	Date	Mission/Remarks
		1962	
Echo (AVT-1)	Thor	L: 1/15/62 D: 1/15/62	Suborbital Communications Test: Canister ejection and opening successful but 135-foot sphere ruptured.
Ranger III	Atlas Agena	L: 1/29/62	Lunar Exploration: TV pictures, hard instrument landing planned; second stage of Agena failed; spacecraft missed the Moon by 22,862 miles on 1/28/62. TV pictures unusable.
Tiros IV	Thor Delta	L: 2/8/62	Meteorology: Supported Friendship 7 flight. Transmitted cloud cover photos to 6/10/62.
Mercury (Friendship 7)	Atlas (MA-6)	L: 2/20/62 D: 2/20/62	Manned: John H. Glenn,Jr.; three orbits. First manned orbital flight by U.S. Four hours, 55 minutes.
Reentry I	Scout	L: 3/1/62 D: 3/1/62	Launch Vehicle Development; Reentry: Desired speed not achieved. (WI)
OSO-I	Thor Delta	L: 3/7/62	Solar Physics: Provided data on approximately 75 solar flares. Last transmission 8/6/63.
Probe B	Scout	L: 3/29/62 D: 3/29/62	Scientific Geoprobe: Electron density measurements; reached 3910 miles. (WI)
Ranger IV	Atlas Agena	L: 4/23/62 D: 4/26/62	Lunar Exploration: TV pictures not obtained; loss of control 2 hours after launch; first U.S. lunar impact (far side).
Saturn Test (SA-2)	Saturn I	L: 4/25/62 D: 4/25/62	Launch Vehicle Test: Carried 95 tons of ballast water in upper stages released at an altitude of 65 miles in order to observe the effect on the upper region of the atmosphere (Project High Water).

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Mission	Vehicle	Date	Mission/Remarks
Ariel I	Thor Delta	L: 4/26/62 D: 5/24/76	Ionosphere: Investigated solar effects. First international satellite. (United Kingdom cooperative)
Centaur Test I	Atlas Centaur	L: 5/8/62 D: 5/8/62	Launch Vehicle Development: Centaur exploded before separation.
Mercury (Aurora 7)	Atlas (MA-7)	L: 5/24/62 D: 5/24/62	Manned: M. Scott Carpenter; three orbits. Four hours 56 minutes.
Tiros V	Thor Delta	L: 6/19/62	Meteorology: Infrared system inoperative; good cloud cover pictures. Last transmission 5/4/63.
Telstar I	Thor Delta	L: 7/10/62	Communications: First privately built satellite. First TV transmission. Last transmission 2/21/63. (Reimbursable)
Echo (AVT-2)	Thor	L: 7/18/62 D: 7/18/62	Suborbital Communications Test: Inflation successful; radar indicated sphere surface not as smooth as planned.
Mariner I	Atlas Agena	L: 7/22/62 D: 7/22/62	Scientific Venus Probe: Atlas deviated from course and was destroyed by Range Safety Officer.
Mariner II	Atlas Agena	L: 8/27/62	Planetary Exploration: Venus; first successful interplanetary probe. Found no magnetic field; high surface temperatures of approximately 800 degrees F. Passed Venus 12/14/62 at 21,648 miles, 109 days after launch.
Reentry II	Scout	L: 8/31/62 D: 8/31/62	Reentry Test (28,000 fps): Late third stage ignition; desired speed not achieved. (WI)

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Mission	Vehicle	Date	Mission/Remarks
Tiros VI	Thor Delta	L: 9/18/62	Meteorology: Infrared sensor omitted. Last transmission 10/11/63.
Alouette I	Thor Agena B	L: 9/29/62	Ionosphere: Radiation belt effects. Second international satellite. (Cooperative with Canada)
Explorer XIV	Thor Delta	L: 10/2/62	Particles and Fields: Data compared with that of Explorer XII. Last transmission 2/17/64.
Mercury (Sigma 7)	Atlas (MA-8)	L: 10/3/62 D: 10/3/62	Manned: Walter M. Schirra; 6 orbits. Nine hours 13 minutes.
Ranger V	Atlas Agena	L: 10/18/62	Lunar Exploration: TV pictures, hard instrument landing planned. Power loss; 450 miles from Moon 10/20/62; no TV pictures obtained.
Explorer XV	Thor Delta	L: 10/27/62	Particles and Fields: Despin system failed, directional detectors almost unusable. Last transmission 5/19/63.
Saturn (SA-3)	Saturn I	L: 11/16/62 D: 11/16/62	Launch Vehicle Development: Second Project High Water using 95 tons of water released at an altitude of 90 nautical miles.
Relay I	Thor Delta	L: 12/13/62	Communications: Initial power failure overcome. Wideband transmission; TV capability of 300 channel telephony, one way. Last transmission 2/65.
Explorer XVI	Scout	L: 12/16/62	Micrometeoroids: First statistical sample; flux level found to lie between estimated extreme; 64 penetrations of sample materials over useful life of 7 months. Sensor area 30 sq. ft. Last transmission 7/22/63. (WI)

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Mission	Vehicle	Date	Mission/Remarks
		1963	
Syncom I	Thor Delta	L: 2/14/63	Communications: First synchronous-type orbit. Radio contact lost at insertion into orbit.
Saturn Test (SA-4)	Saturn I	L: 3/28/63 D: 3/28/63	Launch Vehicle Development: Programmed in-flight cutoff of one of eight engines in cluster; successfully demonstrated propellant utilization system function.
Explorer XVII	Thor Delta	L: 4/3/63 D: 11/24/66	Aeronomy: Discovered belt of neutral helium atoms about Earth. Ceased transmitting experiment data 7/10/63.
Telstar II	Thor Delta	L: 5/7/63	Communications satellite. Last transmission 5/65. (Reimbursable)
Mercury (Faith 7)	Atlas (MA-9)	L: 5/15/63 D: 5/16/63	Manned: L. Gordon Cooper; 22 orbits. Oriented manually for reentry. 34 hours 20 minutes.
RFD-1	Scout	L: 5/22/63 D: 5/22/63	AEC Reactor Mockup Reentry Flight.(Reimbursable)
Tiros VII	Thor Delta	L: 6/19/63	Meteorology: Last transmission 2/3/64.
CRL (USAF)	Scout	L: 6/28/63	Cambridge Research Lab - Geophysics (Reimbursable)
Reentry III	Scout	L: 7/20/63 D: 7/20/63	Reentry Flight Demonstration: Attempted test of an ablation material of super-orbital reentry speeds. (WI)
Syncom II	Thor Delta	L: 7/26/63	Communications: First operational satellite in a synchronous type orbit.

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Mission	Vehicle	Date	Mission/Remarks
Little Joe II Test	Little Joe II #1	L: 8/28/63 D: 8/28/63	Suborbital Apollo Launch Vehicle Test: Booster qualification test with dummy payload. (WSMR)
Explorer XVIII (IMP-A)	Delta (DSV-3C)	L: 11/27/63 D: 12/65	Particles and Fields: Highly elliptical orbit. Confirmed existence of solar wind shock wave on magnetosphere. First Delta with X-258 third stage. Last transmission 5/12/65.
Centaur Test II (AC-2)	Atlas Centaur	L: 11/27/63	Vehicle Development: Instrumented with 2,000 pounds of sensors, equipment and telemetry.
Explorer XIX (AD-A)	Scout	L: 12/19/63	Atmospheric Physics: 12-foot sphere (Explorer IX design); polar orbit. Two (passive) experiments. (WTR)
Tiros VIII	Delta (DSV-3B)	L: 12/21/63	Meteorology: Carried Automatic Picture Transmission (APT) System; allowed real-time readout of local cloud pictures using an inexpensive portable ground station. Last transmission 7/1/67.
		1964	
Relay II	Delta (DSV-3B)	L: 1/21/64	Communications: Wideband transmission; TV capability or 300 channel telephone, one way. Last transmission 5/23/65.
Echo II	Thor Agena	L: 1/25/64 D: 6/7/69	Communications: Rigidized 135-foot sphere; passive. (WTR)
Saturn I (SA-5)	Saturn I	L: 1/29/64 D: 4/30/66	Vehicle Development: Fifth flight of Saturn I; first Block II Saturn, first live flight of the LOX/LH_2 fueled second stage (S-IV). 1146 measurements taken.

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Mission	Vehicle	Date	Mission/Remarks
Ranger VI	Atlas Agena	L: 1/30/64 D: 2/2/64	Lunar Exploration: TV pictures prior to hard landing planned; lunar impact point within 20 miles of target on West edge of Sea of Tranquility; TV system failed to operate.
Beacon Explorer A	Delta (DSV-3B)	L: 3/19/64 D: 3/19/64	Ionosphere: Designed to advance state-of-the-art of lasers for optical tracking and geodesy. Third stage (X-248) fired only half normal time; satellite failed to orbit. First Thor Delta failure after 23 successes; last X-248 third stage.
Ariel II	Scout	L: 3/27/64 D: 11/18/67	Planetary Atmosphere/Radio Astronomy: Continuation of UK International Satellite program; first in program to sample global distribution of ozone with an ultraviolet spectrometer. (WI)
Gemini I	Titan II	L: 4/8/64 D: 4/12/64	Space Vehicle Development: Demonstration of the launch vehicle and guidance system and structural integrity and compatibility of the spacecraft and launch vehicle. 132 measurements taken. Spacecraft was not equipped to separate from second stage.First in Gemini series.
Fire I	Atlas X259	L: 4/14/64 D: 4/14/64	Reentry Test: Investigated the heating environment encountered by a body entering the Earth's atmosphere at high speed. Actual reentry velocity 37,963 fps.

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Mission	Vehicle	Date	Mission/Remarks
Apollo Transonic Abort	Little Joe II	L: 5/13/64 D: 5/13/64	Apollo LES Development: Simulation of Apollo Launch Escape System where high dynamic pressures and transonic speed conditions exist. First launch of Apollo spacecraft boilerplate. (WSMR)
Saturn I (SA-6)	Saturn I	L: 5/28/64 D: 6/1/64	Vehicle Development: Sixth flight of Saturn I; first flight of unmanned boilerplate model of Apollo. 1181 flight measurements taken.
Centaur Test III (AC-3)	Atlas Centaur	L: 6/30/64 D: 6/30/64	Vehicle Development: All six primary objectives successful. Hydraulic pump failure caused short Centaur engine burn.
SERT I	Scout	L: 7/20/64 D: 7/20/64	Ion Engine Test: Ion beam neutralization in space verified. (WI)
Ranger VII	Atlas Agena	L: 7/28/64 D: 7/31/64	Lunar Exploration (Photography): Camera system yielded 4316 high resolution TV pictures with about 2000 times better definition than prior Earth-based photography; objects less than 3 feet discernible. Impact occurred in Sea of Clouds region 8-10 miles from the aim point. 68 hours 36 minutes.
Reentry IV (R-4)	Scout	L: 8/18/64 D: 8/18/64	Reentry Test: Demonstrated ability of one type of low density charring ablator material for Apollo to withstand reentry conditions at 27,950 fps. (WI)
Syncom III	Delta (DSV-3D)	L: 8/19/64	Communications: Third and last of the Syncom series.

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Mission	Vehicle	Date	Mission/Remarks
Explorer XX (IE-A)	Scout	L: 8/25/64	Ionosphere: Measurement of electron density distribution in the F_2 layer by topside sounding on six fixed frequencies. Last transmission 3/30/66. (WTR)
Nimbus I	Thor Agena	L: 8/28/64	Meteorology: Earth orientation allowed complete global cloud cover pictures each 24 hours. Contained APT for local readout AVCS for day and HRIR for nighttime cloud cover. Operated about 26 days. (WTR)
OGO-I	Atlas Agena	L: 9/5/64	Interdisciplinary Studies: Earth-Sun interplanetary space inter-relationships using a highly elliptical orbit to correlate studies of energetic particles and fields, atmospheric physics, solar and other emissions, interplanetary dust. Not all experimental booms deployed properly thereby interferring with the stabilization systems. Mission unsuccessful.
Saturn I (SA-7)	Saturn I	L: 9/18/64 D: 9/22/64	Vehicle Development: Seventh straight Saturn I success. Successful demonstration of Launch Escape System jettisoning.
Explorer XXI (IMP-B)	Delta (DSV-3c)	L: 10/4/64 D: 1/66	Particles and Fields: Detailed study of environment of cislunar space through cosmic ray, solar wind and magnetic field measurements.
RFD 2	Scout	L: 10/9/64 D: 10/9/64	AEC Reactor Mockup Reentry Flight. (Reimbursable)
Explorer XXII	Scout	L: 10/10/64	Ionosphere: Measurement of total electron content of ionosphere by effect on four fixed frequencies transmitted to ground.(WTR)

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Mission	Vehicle	Date	Mission/Remarks
Mariner III	Atlas Agena	L: 11/5/64	Planetary Exploration; Mars: Shroud failed to jettison and communications with the spacecraft were lost.
Explorer XXIII	Scout	L: 11/6/64	Micrometeoroids: Primary sensors were 1- and 2-mil stainless steel pressurized cells; first extended flight test for capacitor detector. Last transmission 11/29/64. (WI)
Explorer XXIV (Air Density) Explorer XXV (Injun)	Scout	L: 11/21/64 D: 10/18/68	Atmospheric Physics: First NASA dual payload launch. Air Density, a 12-foot sphere (Explorer IX and XIX design). Comparison of charged particle energy injection (Injun) with variations in atmospheric temperature and density. Last transmission 7/25/66. (WTR)
Mariner IV	Atlas Agena	L: 11/28/64	Planetary and Interplanetary Exploration; Mars: Encounter occurred 7/14/65 with closest approach 6118 miles. 22 pictures taken. Mariner IV, V, Earth station data obtained Aug.-Sept '67.
Apollo Max. Q Abort	Little Joe II #5	L: 12/8/64 D: 12/8/64	Apollo LES Development: First test of Apollo emergency detection system at abort attitude; first test of the Canard subsystem (for turn-around and stabilization of spacecraft after launch escape) and of the spacecraft protective cover. (WSMR)
Centaur Test IV (AC-4)	Atlas Centaur	L: 12/11/64 D: 12/12/64	Vehicle Development: Carried mass model of Surveyor spacecraft. All primary mission objectives met, test successful; however, secondary test of second burn not accomplished.

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Mission	Vehicle	Date	Mission/Remarks
San Marco I (SM-A)	Scout	L: 12/15/64 D: 9/13/65	Atmospheric Physics: Italian payload, Italian launched. (International Cooperative) (WI)
Explorer XXVI	Delta (DSV-3C)	L: 12/21/64	Particles and Fields: Study of injection, trapping and loss mechanisms of the trapped radiation belt, both natural and artificial. Last transmission 1/21/67.
		1965	
Gemini II	Titan II	L: 1/19/65 D: 1/19/65	Space Vehicle Development: Unmanned reentry test at maximum heating rate; demonstrated structural integrity and systems performance of the spacecraft throughout flight, reentry and parachute water landing.
Tiros IX	Delta (DSV-3C)	L: 1/22/65	Meteorology: First Tiros "cartwheel" configuration for increased coverage of world cloud cover; elliptical orbit. Turned off 2/15/67.
OSO II	Delta (DSV-3C)	L: 2/3/65	Solar Physics: Continuation of OSO-I studies with added ability to scan the solar disc and part of corona. Last transmission 10/7/66.
Pegasus I	Saturn I (SA-9)	L: 2/16/65	Micrometeoroids: First primary use of capacitor-type penetration detector; sensor area: 2,000 sq. ft. Data collection terminated 1/13/68.
Ranger VIII	Atlas Agena	L: 2/17/65 D: 2/20/65	Lunar Photography: 7137 pictures obtained; impact occurred about 15 miles from target in Sea of Tranquility. Total flight time to impact: 64 hours 53 min.

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Mission	Vehicle	Date	Mission/Remarks
Centaur Test V (AC-5)	Atlas Centaur	L: 3/2/65 D: 3/2/65	Vehicle Development: First attempt to place a Surveyor Dynamic Model in a simulated lunar transfer trajectory; Atlas booster failed about 4 seconds after liftoff.
Ranger IX	Atlas Agena	L: 3/21/65 D: 3/24/65	Lunar Photography: 5814 pictures obtained; impact less than 3 miles from target in eastern floor of crater Alphonsus. Pictures converted for live viewing on commercial TV. Final mission of Ranger series. Total flight time to impact: 64 hours 31 minutes.
Gemini III	Titan II	L: 3/23/65 D: 3/23/65	First Manned Gemini; First U.S. two-man crew: Virgil I. Grissom and John W. Young; 3 orbits, 4 hours 53 minutes. First use by crew of orbital maneuvering system. First control of reentry flight path using variable spacecraft lift.
Intelsat I F-1 (Early Bird)	Delta (DSV-3D)	L: 4/6/65	Communications: First commercial satellite launched by NASA for the COMSAT Corp. on a reimbursable basis; up to 240 voice channels, TV or high-speed data. Geostationary orbit over about 27.5 degrees W. longitude.
Explorer XXVII	Scout	L: 4/29/65	Geodesy: Ultrastable oscillators for precise Doppler tracking of orbital perturbations to obtain description of Earth's gravitational field; further laser tracking experimentation. Continuation of Explorer XXII ionospheric measurements. (WI)

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Mission	Vehicle	Date	Mission/Remarks
Apollo High Altitude Abort	Little Joe II #6	L: 5/19/65 D: 5/19/65	Apollo LES Development: Launch vehicle developed a high spin during early powered flight and eventually disintegrated. Launch escape system satisfactorily sensed vehicle malfunction and separated the spacecraft without damage. High altitude abort test objectives not met. (WSMR)
FIRE II	Atlas X259	L: 5/22/65 D: 5/22/65	Reentry Test: Second and last of FIRE program. Reentry velocity of 37,252 achieved. Excellent data, complementing FIRE I data, obtained.
Pegasus II	Saturn I (SA-8)	L: 5/25/65	Micrometeoroids: Data system improved for increased data reliability. Spacecraft circuitry altered to decrease loss of area due to shorting. Near-Earth micrometeoroid environment data was obtained. Data collection terminated 3/14/68.
Explorer XXVIII (IMP-C)	Delta (DSV-3C)	L: 5/29/65 D: 7/4/68	Particles and Fields: Continuation of IMP study of solar-terrestrial relationships, especially magnetosphere boundary; cislunar radiation environment. Orbit somewhat higher than planned.
Gemini IV	Titan II	L: 6/3/65 D: 6/7/65	Manned; Long Duration: James A. McDivitt and Edward H. White; 62 orbits, 97 hours 56 minutes. First U.S. extravehicular activities (36 minutes duration) and first use of personal propulsion unit (both by White). A program of 11 scientific experiments successfully conducted. Near-rendezvous with booster not achieved.

Mission	Vehicle	Date	Mission/Remarks
Tiros X (OT-1)	Delta (DSV-3C)	L: 7/2/65	Meteorology: First Weather Bureau funded spacecraft; spin-stabilized configuration with two 104-degree TV cameras, similar to Tiros VI. Placed in near-perfect Sun-synchronous orbit.
Pegasus III	Saturn I (SA-10)	L: 7/30/65 D: 8/4/69	Micrometeoroids: Last of Pegasus program. Removable "coupons" added for possible retrieval of thermal coating samples for degradation and cratering study. Last of Saturn I vehicle program with 10 out of 10 successes. Data collection terminated 8/29/68.
Scout Evaluation Vehicle (SEV-A)	Scout (S-131-R)	L: 8/10/65	Vehicle Development: Evaluated new Castor II (second stage), FW-4S motor (fourth stage); qualified new spacecraft adapter/separation system; demonstrated yaw maneuver ability, air transportability of fully assembled live Scout. Orbited U.S. Army Secor geodetic satellite. Last transmission 9/10/65. (WI)
Centaur Test VI (AC-6)	Atlas Centaur	L: 8/11/65	Vehicle Development: Fourth successful Atlas Centaur launch accurately injected Surveyor dynamic model into simulated lunar transfer trajectory; demonstrating capability of guidance system.
Gemini V	Titan II	L: 8/21/65 D: 8/29/65	Manned: L.Gordon Cooper,Jr. and Charles Conrad, Jr.; 120 revolutions. 190 hours 56 minutes (8 days). Demonstrated physiological feasibility of lunar mission; evaluated spacecraft performance. Successful simulated rendezvous and 16 of 17 experiments performed; first Gemini use of fuel cell.

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Mission	Vehicle	Date	Mission/Remarks
OSO-C	Thor Delta (DSV-3C)	L: 8/25/65 D: 8/25/65	Solar Physics: Spacecraft similar to OSO-I and II; failed to orbit; premature ignition of third stage.
OGO II	Thor Agena	L: 10/14/65	Interdisciplinary Studies: Similar to OGO-I but in nearly polar, low altitude orbit, emphasizing atmospheric studies and World Magnetic Survey. All appendages successfully deployed and three-axis stabilization temporarily achieved; operated in spin mode due to Horizon Scanner anomaly. Observatory operations discontinued 2/22/68. (WTR)
Gemini VI	Atlas Agena	L: 10/25/65 D: 10/25/65	Rendezvous and Docking Capability Development: Gemini 6 spacecraft was not launched. Agena apparently exploded at initiation of first burn.
Explorer XXIX (GEOS-A)	Delta	L: 11/6/65	Geodesy: Intercomparison of satellite tracking system accuracies, investigate Earth's gravitational field; improve worldwide geodetic datum accuracies and improve positional accuracies of satellite tracking sites. First improved Delta vehicle. Last transmission 1/16/67.
Explorer XXX	Scout	L: 11/19/65	Solar Physics: Monitoring of solar X-rays; to be correlated with optical and radio ground-based observations. Naval Research Laboratory satellite, part of International Quiet Sun Year program. Last transmission 11/7/67. (WI)

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Mission	Vehicle	Date	Mission/Remarks
ISIS X Alouette II Explorer XXXI	Thor Agena B Thor Agena B	L: 11/29/65 L: 11/29/65	Ionosphere: Dual launch for swept frequency top-side sounding (Alouette) and direct compositional measurement (DME) of the ionosphere and for comparable data especially during proximity of initial orbits. First of ISIS series, continuation of joint Canadian-U.S. program. (WTR)
Gemini VII	Titan II	L: 12/4/65 D: 12/18/65	Manned: Frank Borman and James A. Lovell, Jr.; 206 revolutions, 330 hours 35 minutes. Extension of physiological testing and spacecraft performance evaluation. Target for first rendezvous (with Gemini VI-A).
French 1A	Scout	L: 12/6/65	Ionosphere: Study of VLF wavefield in the magnetosphere and irregularities in distribution of the ionosphere. Spacecraft was designed, constructed and tested by the Centre National d'Etudes in France. Last transmission 8/21/68. (International Cooperative) (WTR)
Gemini VI-A	Titan II	L: 12/15/65 D: 12/16/65	Manned: Walter M. Schirra, Jr., and Thomas P. Stafford; 15 revolutions, 25 hours 51 minutes. Accomplished first rendezvous coming within 6 feet of Gemini VII; station keeping was maintained for 5 1/2 hours.
Pioneer VI	Thor Delta (DSV-3E)	L: 12/16/65	Particles and Fields: Study of interplanetary phenomena in ciscytherean space to within about 0.814 AU*. Five of 6 experiments functioned.

*Astronomical Unit. Distance from the Earth to the Sun. 149,599,000 km (93,000,000 mi.)

Mission	Vehicle	Date	Mission/Remarks
		1966	
Intermediate Altitude Abort	Little Joe II (L/V #7)	L: 1/20/66 D: 1/20/66	Apollo LES Development: Last of unmanned ballistic flights; testing Apollo spacecraft atmospheric flight abort capabilities. (WSMR)
ESSA I	Delta (DSV-3C)	L: 2/3/66	Meteorology: Initiated the Tiros Operational Satellite (TOS) system, designated Environmental Survey Satellite (ESSA) No. 1. (TV sensor system.) Turned off 5/8/67. (Reimbursable)
Reentry V(E)	Scout	L: 2/9/66 D: 2/9/66	Reentry Heating Test: Evaluation of the char integrity of a low density phenolic-nylon ablator at 27,000 fps. (WI)
Apollo Saturn	Saturn IB (SA-201)	L: 2/26/66 D: 2/26/66	Launch Vehicle Development: Unmanned, suborbital; demonstrated the compatibility and structural integrity of the spacecraft/launch vehicle configuration; evaluated heatshield performance at high heating rate; command module recovered.
ESSA II	Delta (DSV-3E)	L: 2/28/66	Operational Meteorological Satellite: Advanced version of cartwheel configuration. Permits local readout of daylight cloud cover by APT TV system. Polar Sun-synchronous orbit. (Reimbursable.)

Mission	Vehicle	Date	Mission/Remarks
Gemini VIII	Titan II	L: 3/16/66 D: 3/17/66	Manned: Neil A. Armstrong and David R. Scott; 7 revolutions; 10 hours 42 minutes. First dual launch and docking with Agena. Mission curtailed by short circuit in Orbital Attitude Maneuvering System (OAMS) depleting fuel through thruster #8. First Pacific landing (in preplanned emergency landing area.) Target vehicle exercised through 8-day active life; was available for passive rendezvous.
	Atlas Agena (Target Vehicle)	L: 3/16/66 D: 9/15/67	
Centaur Test VII (AC-8)	Atlas Centaur	L: 4/8/66 D: 5/5/66	Vehicle Development: Seventh Atlas Centaur development flight. Major objective: simulate lunar transfer trajectory using parking orbit, "two burn" indirect ascent. Nominal second burn not achieved. Payload: Surveyor mass model.
OAO I	Atlas Agena	L: 4/8/66	Astronomy: Capable of accurate long duration pointing for ultraviolet, X-ray and gamma ray observations and mapping anywhere in celestial sphere. Spacecraft lost after 2 days due to spacecraft systems anomalies.
Nimbus II	Thor Agena B	L: 5/15/66	Meteorology: R&D similar to Earth-oriented Nimbus I with AVCS, APT and HRIR. Added: Medium Resolution IR Radiometer (MRIR) for Earth heat balance HRIR, readout by APT and orbit data shown on APT. Completed over 2 1/2 years operation with three-axis stabilization. Spacecraft ceased to operate 1/17/69. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
Gemini IX	Atlas Agena	L: 5/17/66 D: 5/17/66	Manned Flight Development: Rendezvous and docking development and to evaluate docked vehicle maneuvering capability and EVA. Target vehicle failed to orbit due to Atlas malfunction; Gemini 9 spacecraft not launched.
Explorer XXXII	Delta (DSV-3C-1A)	L: 5/25/66	Aeronomy: Similar to Explorer XVII but with solar cells for extended life. Apogee higher than planned 650 NM but sensors operated to low levels revealing He and H ion distribution in lower exosphere. Last transmission 3/31/67.
Surveyor I	Atlas Centaur (AC-10)	L: 5/30/66 D: 6/2/66	Lunar Exploration: Achieved soft lunar landing on first engineering test flight (with closed loop guidance) at 2:17 EDT at 2.4 degrees S., 43.43 degrees W. (Ocean of Storms). Selenological data obtained on morphology and lunar origin; bearing strength at Surveyor I site and footpad scale about 5 psi; surface material small cohesive particles with rocks up to 3 feet in size; no loose dust. 10,338 pictures taken during first lunar day, 899 during second (total, 11,237) lost contact 1/7/67.
Gemini IX-A	Titan II	L: 6/3/66 D: 6/6/66	Manned: Thomas P. Stafford and Eugene A. Cernan; 44 revolutions, 72 hours 21 minutes. Unable to dock with ATDA(backup for Gemini Target Vehicle) when shroud failed to clear docking adapter. 2 hours 7 minutes of EVA accomplished; use of Astronaut Maneuvering Unit prevented by difficulty of donning unit and fogging of spacesuit faceplate.
	Atlas Agena (Target Vehicle)	L: 6/1/66 D: 6/11/66	

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Mission	Vehicle	Date	Mission/Remarks
OGO III	Atlas Agena B	L: 6/7/66	Interdisciplinary Studies: First fully successful OGO; first three-axis stabilization in highly elliptical Earth orbit (viewing Earth, space, Sun and orbital plane). Planned apogee reduced to assure Earth tracking throughout orbit. Essentially same experiment as OGO-I.
Pageos I	Thor Agena	L: 6/24/66	Geodesy: Established worldwide triangulation network by optical sighting of Echo I type sphere. (100-foot diameter. (WTR)
Explorer XXXIII (IMP-D)	Thor Delta	L: 7/1/66	Particles and Fields: Planned anchored lunar orbit not obtained. Excess energy orbit produced by launch vehicle precluded lunar capture; consequently, spacecraft was placed in highly elliptical orbit about the Earth.
Apollo Saturn	Saturn IB (SA-203)	L: 7/5/66 D: 7/5/66	Launch Vehicle Development: Liquid hydrogen evaluation flight of the S-IVB stage vent and restart capability. Also test of S-IVB/IU separation and cryogenic storage at zero G. Flight terminated during liquid hydrogen pressure and structural test.
Gemini X	Titan II	L: 7/18/66 D: 7/21/66	Manned: John W. Young and Michael Collins; 43 revolutions, 70 hours 47 minutes.
	Atlas Agena (Target Vehicle)	L: 7/18/66 D: 12/29/66	First dual rendezvous (with GTV 10 then with GTV 8); first docked vehicle maneuvers; three hatch openings: standup EVA(87 min.), terminated due to fumes; umbilical EVA(27 min.), terminated to conserve maneuvering propellant on spacecraft; equipment jettisoned before reentry. Micrometeoroid experiment retrieved from GTV 8.

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Mission	Vehicle	Date	Mission/Remarks
Lunar Orbiter I	Atlas Agena	L: 8/10/66 D: 10/29/66	Lunar Photography: Total of 207 sets(frames) of medium and high resolution pictures taken; 38 from initial 169 from low orbit. Areas covered: 9 primary and 7 potential Apollo landing sites (including Surveyor I site), 11 backside and 2 Earth-Moon. Medium resolution pictures good, high resolution smeared. Readout completed 9/13/66, intentionally impacted to avoid interference with second mission.
Pioneer VII	Delta	L: 8/17/66	Particles and Fields: Continued program of measurements over the solar cycle at widely separated points in interplanetary space; about 1.125 AU aphelion. Four of 6 experiments on.
Apollo Saturn	Saturn IB (AS-202)	L: 8/25/66 D: 8/25/66	Apollo Launch Vehicle and Spacecraft Development: Unmanned, suborbital. Continued test of CSM subsystems and space vehicle structural integrity and compatibility. 1 hour 23 minute flight evaluated heatshield performance at high heat load; CM 011 recovered near Wake Island.
Gemini XI	Titan II	L: 9/12/66 D: 9/15/66	Manned: Charles Conrad,Jr. and Richard F. Gordon,Jr.; 44 rev., 71 hours 17 min.
	Atlas Agena (Target Vehicle)	L: 9/12/66 D: 12/30/66	Rendezvous and docking achieved in 1 hour 34 min. within first spacecraft revolution. 2 hours 41 min. EVA by Gordon; umbilical EVA 44 min. Tethered spacecraft experiment successful, computer controlled reentry.

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Mission	Vehicle	Date	Mission/Remarks
Surveyor II	Atlas Centaur	L: 9/20/66 D: 9/23/66	Lunar Exploration: During midcourse maneuver, one of the spacecraft's three engines did not ignite causing incorrectable tumbling. Contact lost 5 1/2 hours prior to predicted impact time. Target Site: Sinus Medii.
ESSA III	Delta (DSV-3E)	L: 10/2/66	Meteorology: First Advanced Vidicon Camera System (AVCS) in Tiros/TOS series; also carried IR Earth heat balance sensor. Advanced cartwheel design, placed in near polar Sun-synchronous orbit. First Delta vehicle launch from WTR. (Reimbursable)
Centaur Test VIII	Atlas Centaur	L: 10/26/66 D: 11/6/66	Vehicle Development: Second two-burn test for parking orbit, indirect ascent capability; eighth and final Centaur development test planned. Surveyor mass model injected into simulated lunar transfer orbit.
Intelsat II	Delta (DSV-3E)	L: 10/26/66	Communications: Second Comsat Corp. commercial satellite, NASA providing reimbursable launch support. Apogee motor nozzle blown off shortly after motor ignited. Planned geostationary orbit not achieved. Spacecraft orbit allowed about 8 hours of use per day. Last transmission 10/31/66.
Lunar Orbiter II	Atlas Agena	L: 11/6/66 D: 10/11/67	Lunar Photography: Spacecraft completed taking 211 frames (422 medium and high resolution pictures)11/26/66. Spacecraft responded to over 2870 commands and performed over 280 maneuvers. Readout was completed 12/6/66.

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Mission	Vehicle	Date	Mission/Remarks
Gemini XII	Titan II	L: 11/11/66 D: 11/15/66	Manned: James A. Lovell,Jr. and Edwin E. Aldrin, Jr.; 59 revolutions; 94 hours 34 minutes. Final mission of Gemini series emphasized evaluation of EVA (Aldrin: 5 hours 30 min.)tasks workload including two "standups" totaling 208 min. and 122 min. of umbilical EVA. Also 14 scientific experiments performed and solar eclipse pictures taken. The target vehicle's primary propulsion not usable for high elliptical orbit maneuver.
	Atlas Agena (Target Vehicle)	L: 11/11/66 D: 12/23/66	
ATS I	Atlas Agena	L: 12/7/66	Applications and Technology: Synchronous, circular equatorial orbit over 151 degrees W. longitude (near Hawaii). The Spin Scan Cloud Camera returned the first photo covering nearly the entire disc of the Earth 12/9/66. Communications, spacecraft technology and science experiments included in payload.
Biosatellite I	Delta (DSV-3G)	L: 12/14/66 D: 2/15/67	Biology: Spacecraft completed 3 days of operation with good environmental control and attitude control. All biological experiment events occurred. The radiation source functioned as planned. Retrofire did not occur and recovery was not possible.

Mission	Vehicle	Date	Mission/Remarks
		1967	
Intelsat II F-2	Delta (DSV-3E)	L: 1/11/67	Communications: Comsat commercial satellite; NASA providing reimbursable launch support. Capable of handling TV data transmission or up to 240 voice channels; part of capacity to be purchased by NASA for Apollo support. Placed about 164 degrees E. in the vicinity of Marshall Islands. Last transmission 1/14/67.
ESSA IV	Delta (DSV-3E)	L: 1/26/67	Meteorology: Advanced version of cartwheel configuration. Nearly-polar-Sun-synchronous orbit. Good APT pictures returned 1/28/67. 1/29/67 shutter problem made one (of two redundant) APT cameras aboard inoperative. Deactivated 12/6/67. (Reimbursable) (WTR)
Lunar Orbiter III	Atlas Agena	L: 2/5/67 D: 10/9/67	Lunar Photography: 211 sets (frames) of medium and high resolution pictures taken. Last frame not taken to cut bimat early. Picture readout terminated by a transient signal which ended film movement. 72 per cent of photos readout. Readout completed for 6 primary sites, parts of 6 other sites. Partial readout returned on 31 secondary sites.
OSO III (OSO E)	Delta (DSV-3C)	L: 3/8/67	Solar Physics: Similar to OSO-I and II; carried experiments identical to OSO-C unsuccessfully launched 8/25/65 for obtaining high resolution spectral data within range of 8A-1300A.

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Mission	Vehicle	Date	Mission/Remarks
Intelsat II F-3	Delta	L: 3/23/67	Communications: Comsat commercial satellite similar to Intelsat II-A and II-B. Spacecraft placed about 10 degrees W. over Atlantic Ocean. (Reimbursable)
ATS II	Atlas Agena	L: 4/6/67 D: 9/2/69	Gravity Gradient Experiment: Lack of Agena second burn resulted in elliptical, not circular, orbit precluding meaningful evaluation of gravity gradient experiment and resulted in limited data from 11 other experiments; communications, meteorology, albedo, 8 environmental. Unsuccessful.
Surveyor III	Atlas Centaur	L: 4/17/67 D: 4/20/67	Lunar Exploration: Achieved soft landing 4/20/67. Closed loop radar failed during landing and spacecraft landed three times on inertial guidance before its verniers cut off. Surface Sampler experiment discovered pebbles of 6 inches and 10 psi bearing strength. The spacecraft returned 6315 pictures. Site: Oceanus Procellarum, 3.33 degrees S., 23.17 degrees W.
ESSA V (TOS-C)	Delta (DSV-3E)	L: 4/20/67	Meteorology: Carried Advanced Vidicon Camera System. In Sun-synchronous orbit with 3 p.m. local equator crossing time. Officially deactivated by ESSA 2/20/70. (WTR) (Reimbursable)
San Marco II	Scout	L: 4/26/67 D: 10/14/67	Atmospheric Physics: Italian payload launched from the Platform in the Indian Ocean. Spacecraft carried drag and ionospheric experiments. (International Cooperative)

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Mission	Vehicle	Date	Mission/Remarks
Lunar Orbiter IV	Atlas Agena	L: 5/4/67 D: 10/6/67	Lunar Photography: First photos returned 5/11/67. Problems developed with Camera Thermal Door. Read-out completed 5/27/67. High resolution photos of over 99 per cent of frontside of Moon returned; 80 per cent of backside has been photo-graphed by Lunar Orbiter I-IV.
Ariel III (UK-E)	Scout	L: 5/5/67 D: 12/14/70	Atmospheric Physics: U.K. payload. All five experi-ments returned data. (Inter-national Cooperative) (WTR)
Explorer XXXIV (IMP-F)	Delta	L: 5/24/67 D: 5/3/69	Particles and Fields: Fifth IMP spacecraft. Investiga-ting region between the mag-netosheath and the shock front. Launched during Class III Bright solar flare. (WTR)
ESRO II-A	Scout	L: 5/29/67 D: 5/29/67	Solar Astronomy and Cosmic Rays: All telemetry lost 8 seconds prior to third-stage cutoff. No fourth-stage burn, satellite splashed down in South Pacific. (International Cooperative) (WTR)
Mariner V (Venus 67)	Atlas Agena	L: 6/14/67	Planetary/Interplanetary Exploration: All science and engineering subsystems nominal through encounter with Venus; data indicates Moon-like effect on solar plasma, strong H_2 corona com-parable to Earth's, 72 to 87 per cent CO_2 atmosphere with balance probably nitro-gen, no 0_2. Closest approach: 3,946 km.
Surveyor IV	Atlas Agena (single burn)	L: 7/14/67 D: 7/17/67	Lunar Exploration: All launch vehicle and space-craft performance nominal until last 2 seconds of 42 second retro burn when all communications were lost with spacecraft. Target site: Sinus Medii.

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Mission	Vehicle	Date	Mission/Remarks
Explorer XXXV (IMP-E)	Delta (DSV-3E)	L: 7/19/67	Particles and Fields: Lunar orbit achieved 7/22/67(first without midcourse correction capability)permitting more detailed study of Earth's magnetosphere. No lunar magnetic field or "bow shock wave" observed.
OGO IV (OGO-D, POGO)	Thor Agena	L: 7/28/67 D: 8/16/72	Interdisciplinary studies: Similar to OGO-II, to obtain data during increased solar activity to complement near solar minimum OGO-II data. Carried 20 experiments (10 from 9 universities, one foreign; 5 GSFC; 1 JPL; 1 SAO; 2 NRL; 1 CRL) emphasizing atmospheric/ionospheric phenomena of near-Earth environment. (WTR)
Lunar Orbiter V	Atlas Agena	L: 8/1/67 D: 1/31/68	Lunar Photography: Last launch in the series of missions to perform mapping of entire lunar surface. Specifically provided: detailed coverage of 36 scientific interest sites; 5 Apollo sites; completed high altitude far side coverage; a full view of Earth in near full phase; 100 per cent readout accomplished of all 212 frames taken; provided near-lunar micrometeoroid and radiation data.
Biosatellite II	Delta (DSV-3G)	L: 9/7/67 D: 9/9/67	Biology: First successful U.S. satellite exclusively for bioscience; obtained excellent data on specimens of cells, plants and low order animals; reentered one day early. Capsule recovered by aircatch.

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Mission	Vehicle	Date	Mission/Remarks
Surveyor V	Atlas Centaur	L: 9/8/67 D: 9/11/67	Lunar Exploration: First alpha scatter data; indicated basaltic character of area sampled in Mare Tranquillitatus, 23.19 degrees E. and 1.52 degrees N. Achieved 83 hours alpha scatter data and 18,006 photos in first lunar day. Survived first lunar night but, as expected, subsequent data obtained of lower quality.
Intelsat II F-4	Delta (DSV-3E)	L: 9/28/67	Communications: Comsat commercial satellite, similar to Intelsats II-A,B and C with up to 240 voice channels; to supplement and backup B. Current orbit 63 degrees W. over Pacific Ocean. Provides test of minimum angular separation of B and D without intersatellite interference. (Reimbursable)
OSO IV	Delta (DSV-3C)	L: 10/18/67	Solar Physics: Continuation and expansion of data obtained by OSO program on high resolution spectral data (within range of 1A-1350A) from pointed solar experiments including raster scans of solar disk. Retired 11/1/71.
RAM C-1	Scout	L: 10/19/67 D: 10/19/67	Reentry Environment: Investigation of plasma flow field for solution of associated communications problems of reentry between 25-27,000 fps using water addition techniques. Use of X-band telemetry and Plasma and ablation effects on antennas also evaluated. About 25,000 fps reentry achieved. (WI)

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Mission	Vehicle	Date	Mission/Remarks
ATS III	Atlas Agena	L: 11/5/67	Applications and Technology: Nine experiments involving communications, meteorology, Earth photography in color, navigation, stabilization and pointing, degradation of surfaces in space and ionosphere.
Surveyor VI	Atlas Centaur	L: 11/7/67 D: 11/10/67	Lunar Exploration: Sinus Medii, 0.25 degrees N, 1.3 degrees W; 30,065 TV pictures, 27 hours on-surface alpha scatter analytical time obtained. First liftoff from lunar surface: moved 10 feet to a new location. Sixth in a series of seven Surveyor flights intended to perfect the technology of soft landing on the Moon and provide basic scientific and engineering data in support of Apollo.
Apollo IV (AS-501/CSM-017/LTA-10R)	Saturn V	L: 11/9/67 D: 11/9/67	Launch Vehicle and Spacecraft Development: First launch of Saturn V vehicle (8 1/2 hour mission) to demonstrate launch vehicle capability and spacecraft development. CSM-017 tested Apollo heat shield and simulation of new hatch at lunar reentry velocity; recovered near Hawaii. First launch from Complex 39. Two orbits of 88.3 minutes, then boosted to 1722 km apogee.
ESSA VI (TOS-D)	Delta (DSV-3E)	L: 11/10/67	Meteorology: Carried two TV systems used for the APT ground stations. Sun-synchronous orbit. Spacecraft and launch costs funded by ESSA. (Reimbursable)(WTR)

Mission	Vehicle	Date	Mission/Remarks
Pioneer VIII (Test and Training Satellite-1)	Delta (DSV-3E)	L: 12/13/67 L: 12/13/67 D: 4/28/68	Particles and Fields: Continued program of measurements over solar cycle at widely separated points in interplanetary space about 1.09 AU Aphelion. Six of 6 experiments functioned. (TTS-1 -- a "piggyback" secondary objective payload for the checkout, training and development of MSFN stations and techniques.
		1968	
Surveyor VII	Atlas Centaur	L: 1/7/68 D: 1/10/68	Lunar Exploration: Last Surveyor, emphasized scientific objectives, landed on Tycho ejecta blanket 40.89 degrees S., 11.44 degrees W.; first combination of the three major experiments: TV (2,274 on first day), alpha scatter (43 hours on surface analytical time) and surface sampler.
Explorer XXXVI GEOS II	Delta (DSV-3E)	L: 1/11/68	Geodesy: Nearly identical to GEOS-A with C-band transponder and reflector and CW laser detector added. Continued support of the National Geodetic Satellite Program objectives. (WTR)
Apollo V (AS-204/LM) (ascent) (descent)	Saturn IB	L: 1/22/68 D: 1/24/68 D: 2/12/68	Lunar Module (LM) Spacecraft Development: First flight test of Apollo LM verified ascent and descent stages propulsion systems, including restart and throttle operations. Also evaluated LM staging and S-IVB/IU orbital performance.

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Mission	Vehicle	Date	Mission/Remarks
OGO V	Atlas Agena D (SLV-3A)	L: 3/4/68	Interdisciplinary Studies: Three-axis stabilized in highly elliptical Earth orbit. Countries providing experiments include England, France and The Netherlands. First satellite spark-chamber experiment. First detection of electric fields in Earth's bow shock. Retired 7/14/72.
Explorer XXXVII (Solar Explorer-B)	Scout	L: 3/5/68	Second joint NRL-NASA Spacecraft: Monitored Sun's energetic X-ray emissions intensity and time histories and provided real time solar data through COSPAR to scientific community. Six of 8 experiments functioned. Last transmission 3/16/70. (WI)
Apollo VI (AS-502/ CSM-020/ LTA-2R)	Saturn V	L: 4/4/68 D: 4/4/68	Launch Vehicle Development: Anomalies experienced with J-2 engine Augmented Spark Ignitors on second and third stages. S-IVB restart not accomplished. F-1 engines on first stage synchronized creating longitudinal vibration of unacceptable amount. Spacecraft performance nominal.
Reentry VI	Scout	L: 4/27/68 D: 4/27/68	Reentry Heating Test: Designed to support the advancement of atmospheric entry technology. Spacecraft performance nominal. (WI)
International Radiation Investigation Satellite I (ESRO IIB)	Scout	L: 5/17/68 D: 5/8/71	Radiation: The scientific objective resulted in measuring radiation from the Sun and cosmic rays, including X-rays, HE, II line, Lyman Alpha, trapped radiation, solar and Van Allen belt protons, cosmic ray protons, Alpha particles and high energy electrons.(WTR) (International Cooperative)

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Mission	Vehicle	Date	Mission/Remarks
Nimbus B	Thorad Agena D	L: 5/18/68 D: 5/18/68	Meteorology: Carried two experiments flown on Nimbus II and five new ones plus RTG (SNAP-19) experiment. Planned 1,111-km Sun-synchronous polar orbit. Launch vehicle destroyed by range safety after 2 minutes.(WTR)
Explorer XXXVIII	Delta	L: 7/4/68	Radio Astronomy: Four antennas were deployed 10/8/68 to their full and final length 750 feet(1500 feet tip-to-tip). The damper boom was also extended to its full length of 315 feet (630 feet tip-to-tip). Two of 2 experiments function. (WTR)
Explorer XXXIX (Air Density) Explorer XL (Injun V)	Scout	L: 8/8/68 L: 8/8/68	Interdisciplinary project to continue detailed scientific study of density and radiation characteristics of Earth's upper atmosphere at a time of high solar activity. Four of 4 experiments functioned. (WTR)
ATS IV	Atlas Centaur	L: 8/10/68 D: 10/17/68	Applications and Technology: performed communication, meterological, technology and science experiments. Gravity gradient experiment could not be conducted because spacecraft did not separate from Centaur.
ESSA VII (TOS-E)	Delta	L: 8/16/68	Meteorology: TOS-E, an AVCS-type spacecraft, in a Sun-synchronous orbit having a local equator crossing time between 2:35 p.m and 2:55 p.m. so that daily AVCS pictures of the entire globe can be obtained. One AVCS operated. (Reimbursable) (WTR)
RAM C-II	Scout	L: 8/22/68 D: 8/22/68	To measure electron and ion concentrations in the flow field at discrete spacecraft locations during reentry(WI).

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Mission	Vehicle	Date	Mission/Remarks
Intelsat III F-1	Delta	L: 9/19/68 D: 9/19/68	Communications: Third generation Comsat commercial satellite. Improved long-tank Thor Delta destroyed itself 1 minute 8 seconds into the mission. Control system failure(Reimbursable).
Aurorae (ESRO-I)	Scout	L: 10/3/68 D: 6/26/70	Carried 8 experiments designed to perform an integrated study of the high latitude ionosphere.(WTR) (International Cooperative)
Apollo 7 (AS-205/ CSM-101)	Saturn IB	L: 10/11/68 D: 10/22/68	Manned, CSM Operations: Walter M. Schirra, Donn F. Eisele and Walter Cunningham. Eight successful Service Propulsion firings; 7 live TV sessions with crew returned. Rendezvous with S-IVB stage to 70 feet performed. Astronauts developed colds in orbit. Duration: 260 hours 8 minutes.
Pioneer IX (Test and Training Satellite)	Delta (DSV-3E)	L: 11/8/68	To collect scientific data on the electromagnetic and plasma properties of the interplanetary medium for a period covering 6 or more passages of solar activity centers. Six of 6 experiments functioned (TETRS-2, a piggyback secondary objective payload for the checkout, training and development of MSFN stations and techniques.)
HEOS-A	Delta	L: 12/5/68 D: 10/28/75	First NASA/ESRO reimbursable mission. Scientific satellite for the investigation of interplanetary magnetic fields and the study of solar and cosmic ray particles. Eight of 8 experiments operated.(Reimbursable)

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Mission	Vehicle	Date	Mission/Remarks
OAO II (A2)	Atlas Centaur	L: 12/7/68	Astronomy: Heaviest, most complex U.S. scientific spacecraft built to date. Astronomy investigations by experiments developed by Univ. of Wisconsin and Smithsonian Astrophysical Observatory. Observational objectives include celestial objects in the ultraviolet region of the electromagnetic spectrum. Three of the 4 Smithsonian instruments functioned, but this instrument was placed on standby in April 1970 to concentrate on the Wis. instrument. Six of the 7 Wis. instruments functioned.
ESSA VIII (TOS-F)	Delta	L: 12/15/68	Meteorology: Carried two APT camera systems to obtain daily cloud photos all over the globe. (Reimbursable) (WTR)
Intelsat III F-2	Delta	L: 12/18/68	Communications: Comsat commercial satellite for commercial service between U.S. and Puerto Rico.(Reimbursable)
Apollo 8 (AS-503/ CSM-103)	Saturn V	L: 12/21/68 D: 12/27/68	First Manned Saturn V Flight: Frank Borman, James A. Lovell, Jr. and William A. Anders, demonstrated crew, space vehicle and mission support facilities performance during a manned lunar orbital mission; 147 hours duration. Mission accomplished 10 lunar orbits returning good lunar photography.

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Mission	Vehicle	Date	Mission/Remarks
		1969	
OSO V	Delta	L: 1/22/69	Solar Physics: Primary objective to obtain high spectral resolution data (within the 1A-1250A range) from onboard solar experiments pointed toward the Sun.
International Satellite for Ionospheric Studies (ISIS-A)	Delta	L: 1/30/69	Ionospheric Studies: Third mission in a series of five missions in the cooperative U.S.- Canadian space program. (WTR)
Intelsat III F-3	Delta	L: 2/5/69	Communications: 1200 two-way circuits for voice, TV and other commercial services; orbit 62 degrees E. longitude, over Indian Ocean. (Reimbursable)
Mariner VI	Atlas Centaur	L: 2/25/69 D: 5/11/71	Planetary/Interplanetary Exploration: Midcourse correction successfully executed to achieve a Mars flyby within 2,000 miles 7/31/69. Designed to perform investigations of atmospheric structures and compositions and to return TV photos of surface topography.
ESSA IX (TOS-G)	Delta	L: 2/26/69	Meteorology: Ninth and last mission of TOS series. (Reimbursable)
Apollo 9 (AS-504/ CSM-104/ LM-3)	Saturn V	L: 3/3/69 D: 3/13/69	First manned flight of all manned lunar hardware in Earth orbit: James McDivitt, David Scott and Russell Schweickart. First manned flight of LM. Successful LM active rendezvous. EVA by Schweickart for 67 minutes. Atlantic recovery postponed one orbit due to weather; 241 hours 1 minute duration. EVA by Scott, 61 minutes.

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Mission	Vehicle	Date	Mission/Remarks
Mariner VII	Atlas Centaur	L: 3/27/69 D: 12/30/70	Planetary/Interplanetary Exploration: Spacecraft identical to Mariner VI. Midcourse correction successful for 3,518 km flyby. Flyby: 8/5/69.
Nimbus III	Thorad Agena	L: 4/14/69 D: 12/29/71	Meteorology: Carried experiments identical to those carried by Nimbus B. IRIS instrument failed after meeting objectives. (WTR)
Apollo 10 (AS-505/ CSM-106/ LM-4)	Saturn V	L: 5/18/69 D: 5/26/69	Manned lunar mission development flight to evaluate LM performance in the cislunar and lunar environment. Eugene A. Cernan, John W. Young and Thomas P. Stafford. Major activities: descent of LM to within 50,000 feet of lunar surface and 19 color TV transmissions. Pacific splashdown; 192 hours 3 minutes duration.
Intelsat III F-4	Thor Delta	L: 5/22/69	Global telecommunications satellite. 174 degrees E. longitude; over Pacific Ocean. (Comsat Reimbursable)
OGO VI	Thorad Agena D	L: 6/5/69	Interdisciplinary Studies: Observatory appendage deployment, Sun acquisition and Earth acquisition were completed successfully. Three-axis stabilization was achieved. Two 30-foot antennas deployed. (WTR)
Explorer XLI (IMP-G)	Thor Delta	L: 6/21/69 D: 12/23/72	Particles and Fields: Continued study of the environment within and beyond the Earth's magnetosphere during period of high solar activity. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
Biosatellite III (BIOS-D)	Delta (DSV-3N)	L: 6/29/69 D: 7/7/69	Biology: Spacecraft in orbit 8 1/2 days with all life support parameters controlled within specification before deteriorating physiological condition of monkey required recovery of capsule. The animal, when given intensive care in the laboratory, responded initially. However, it expired suddenly about 8 hours later. An autopsy showed death due to heart failure brought about by problems associated with weightlessness and a lower than normal body temperature. Mission judged unsuccessful.
Apollo 11 (AS-506/ CSM-107/ LM-5)	Saturn V	L: 7/16/69 D: 7/24/69	First manned lunar mission: Limited selenological inspection, photography, survey, evaluation and sampling of the lunar soil. Assessed the capability and limitations of an astronaut and his equipment in the lunar environment. Astronauts: Neil A. Armstrong, Michael Collins and Edwin E. Aldrin, Jr. Touchdown on lunar surface was July 20. Pacific splashdown 7/24/69, 12:51 p.m. EDT.; 195 hours 18 min. duration. Returned 44 lb. lunar material.
Intelsat III F-5	Delta	L: 7/26/69	Global telecommunications: To form part of a global communication, commercial satellite system. Spacecraft did not achieve desired orbit due to third stage failure. (Comsat Reimbursable)
OSO VI	Delta	L: 8/9/69	Solar Physics: Primary objective to obtain high spectral resolution data (within the 10 to 20 Kev and 1A to 1300 A range) from onboard solar experiments pointed toward the Sun.

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Mission	Vehicle	Date	Mission/Remarks
ATS V	Atlas Centaur	L: 8/12/69	Applications and Technology: To conduct a carefully instrumented gravity gradient orientation experiment directed toward providing the basic design information for the stabilization and control of long-lived spacecraft in synchronous orbit. Mission unsuccessful due to inability to perform primary objectives of the gravity gradient experiment.
Pioneer E	Delta	L: 8/27/69 D: 8/27/69	To obtain polar plasma, magnetic field and cosmic ray measurements near the orbital path of the Earth but outside the Earth's region of influence. This was the fifth and last launch of early Pioneer series. Launch vehicle destroyed by Range Safety Officer after 8 min. 2 sec.
Boreas (ESRO-IB)	Scout	L: 10/1/69 D: 11/23/69	Second satellite of the ESRO-I Project. Satellites designed to study ionospheric and auroral phenomena particularly over the northern polar regions in darkness in the winter. Carried 8 experiments.(Reimbursable)(WTR)
German Research Satellite-A (AZUR)	Scout	L: 11/8/69	Particles and Fields: Study of the inner Van Allen belt, the auroral zones of the Northern Hemisphere and the spectral variations of solar particles versus time during solar flares. (International Cooperative) (WTR)

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Mission	Vehicle	Date	Mission/Remarks
Apollo 12 (AS-507/ CSM-108/ LM-6)	Saturn V	L: 11/14/69 D: 11/24/69	Second manned lunar landing mission: Demonstrated point landing capability, sampled more area, deployed ALSEP, investigated the Surveyor III spacecraft and obtained photographs of candidate exploration sites. Astronauts: Charles Conrad, Jr., Richard F. Gordon, Jr. and Alan Bean. Touchdown on lunar surface 11/19/69. Total EVA time 15 hours 32 minutes. Duration: 244 hours 36 minutes; returned 75 lb. lunar material.
Skynet A	Delta	L: 11/22/69	Communications: Equatorial synchronous satellite located over Indian Ocean. (International Reimbursable)
		1970	
Intelsat III F-6	Delta	L: 1/14/70	Global telecommunications: To form part of a global communication, commercial satellite system. (Reimbursable)
ITOS I (Tiros-M)	Delta	L: 1/23/70	Meteorology: Second generation meteorology satellite carried TV, APT and scanning radiometers for global cloud data for remote and local readout both day and night. First launch of the Delta with 6 solid strap-ons. (OSCAR ham radio satellite launched from the Delta in orbit.) Deactivated by NOAA 6/17/71.
SERT II	Thor Agena	L: 2/4/70	Ion Engine Test: Demonstrate the capability of an electric ion thruster system to operate 6 months in space. Mission unsuccessful because it operated short of its full duration due to electrical shortage in high voltage system. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
NATOSAT I (NATO-A)	Delta	L: 3/20/70	Communications: To place a military communications satellite into a stationary equatorial orbit. (International Reimbursable)
Nimbus IV	Thor Agena	L: 4/8/70	Meteorology: Fifth in a series of 7 advanced research and development weather satellites. Seven of 9 experiments were operational.
Apollo 13 (AS-508/ CSM-109/ LM-7)	Saturn V	L: 4/11/70 D: 4/17/70	Third manned lunar landing attempt aborted after 56 hours GET due to loss of pressure in liquid oxygen in Service Module and the failure of fuel cells 1 and 3. Astronauts: James A. Lovell, Jr., Fred W. Haise, Jr. and John L. Swigert, Jr. Total flight time was 142 hours 55 minutes. Splashdown in Pacific Ocean.
Intelsat III F-7	Delta	L: 4/22/70	Global Telecommunications: To form part of a global communications, commerical satellite system. (Comsat Reimbursable)
Intelsat III F-8	Delta	L: 7/23/70	Global Telecommunications: To form part of a global communications, commercial satellite system. Last launch for Intelsat III series. Did not orbit. (Comsat Reimbursable)
Skynet 2	Delta	L: 8/19/70	U.K. Communications Satellite. Vehicle failed. (Reimbursable)
RAM C-3	Scout	L: 9/30/70	Compare the effectiveness of a liquid electrophilic (Freon) with water in alleviating radio blackout during a 25,000 fps reentry.

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Mission	Vehicle	Date	Mission/Remarks
OFO 1	Scout	L: 11/9/70 D: 5/9/71	Obtain direct measurements of the (vestibular nerve) activity changes and study the adaptation of the otolith system (in two bull frogs) under conditions of weightlessness and acceleration. Vehicle also carried secondary payload: Radiation/ Meteoroid Satellite(RMS);RMS remained attached to Scout fourth stage.
(RMS)		L: 11/9/70 D: 2/7/71	
OAO B	Atlas Centaur	L: 11/30/70 D: 11/30/70	To obtain moderate resolution spectrophotometric data in ultraviolet bands between 1100 and 4000A; to investigate photometry of peculiar stars, the law of interstellar reddening, magnitude and intensity of Lyman-alpha red shift for nearby galaxies, spectra of emission and reflection nebulae. Nose fairing separation system failed to separate at proper time.(Vehicle failure)
ITOS A (NOAA-1)	Delta	L: 12/11/70	To conduct in-orbit engineering evaluation so that the daytime and nighttime cloud-cover observations can be obtained regularly and dependably in both direct readout and stored modes of operation. A Cylindrical Electrostatic Probe Experiment(CEPE) was carried piggyback, permanently attached to the Delta second stage. Deactivated by NOAA 8/19/71. (Reimbursable)
Explorer 42 (SAS-A)	Scout	L: 12/12/70	To develop a catalog of celestial X-ray sources by systematic scanning of the celestial sphere in the energy range 2-20 Kev. First orbiting X-ray satellite. (SM)

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Mission	Vehicle	Date	Mission/Remarks
		1971	
Intelsat IV F-2	Atlas Centaur	L: 1/25/71	Global Telecommunications: To form part of a global communications commercial satellite system. First launch of the Intelsat IV series.(Comsat Reimbursable)
Apollo 14 (AS-509/ CSM-110/ LM-8)	Saturn V	L: 1/31/71 D: 2/9/71	Third manned lunar landing: Astronauts: Alan B. Shepard, Stuart A. Roosa and Edgar D. Mitchell. Total flight time 216 hours 42 minutes. Splash-down in Pacific Ocean 2/9/71. Returned 98 lb. lunar material.
NATOSAT 2 (NATO-B)	Delta	L: 2/2/71	Communications: To place a military communications satellite into a stationary equatorial orbit. (NATO Reimbursable)
Explorer 43 (IMP-I)	Delta	L: 3/13/71 D: 10/2/74	Extend knowledge of solar-lunar-terrestrial relation-ships by conducting a con-tinuing study of the radia-tion environment of the interplanetary magnetic field and its dynamic rela-tionships with solar particles.
ISIS 2	Delta	L: 3/31/71	To study electron production and loss and large scale transport of ionization in the ionosphere.(Canadian International Cooperative) (WTR)
San Marco 3	Scout	L: 4/24/71 D: 11/29/71	To investigate and define the equatorial neutral par-ticle atmosphere in terms of density, composition and temperature behavior and variations resulting from solar and geomagnetic acti-vities. Vehicle provided by NASA on non-reimbursable basis. (Italian) (SM)

Mission	Vehicle	Date	Mission/Remarks
Mariner Mars 71			To study the dynamic characteristics of the planet Mars
Mariner 8	Atlas Centaur	L: 5/8/71 D: 5/8/71	from orbit for a minimum period of 90 days also to map 70 per cent of the planet.
Mariner 9	Atlas Centaur	L: 5/30/71	Mariner 8 failed because of vehicle malfunction. Mariner 9 entered Mars orbit 11/13/71. It responded to 37,764 commands and transmitted 6,876 pictures of the Mars surface. All scientific instruments operated successfully. Mariner 9 terminated 6:31 p.m. EDT 10/27/72.
Planetary Atmosphere Experiment Test	Scout	L: 6/20/71	Demonstrate the ability to determine the structure and comparison of the atmosphere through onboard instrumentation from a probe vehicle entering the atmosphere at high speed (25,000 fps).(WI)
Explorer 44 (SOLRAD 10) (NRL)	Scout	L: 7/8/71	To monitor the Sun's X-ray and ultraviolet emissions in order to better understand the solar physical processes and to improve the prediction techniques of solar activity and ionospheric disturbances. Vehicle provided by NASA on non-reimbursable basis. (WI)
Apollo 15 (AS-510/ CSM-112/ LM-10)	Saturn V	L: 7/26/71 D: 8/7/71	Fourth manned lunar landing and first of Apollo "J" series missions which carry Lunar Roving Vehicle. Astronauts: David R. Scott, Alfred M. Worden and James B. Irwin. Total flight time 295 hours 12 minutes. Total EVA time 18 hours 46 minutes. Worden's in-flight EVA 38 minutes 12 seconds performed out-of-Earth orbit. Splashdown in Pacific about 288 nautical miles due north of Pearl Harbor. Returned 173 lb. lunar material.

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Mission	Vehicle	Date	Mission/Remarks
Cooperative Applications Satellite(CAS-A) (EOLE 1)	Scout	L: 8/16/71	Data Collection: Cooperation with France in Space Meteorology Project using instrumented balloons and an Earth orbiting satellite to obtain in-situ speed and direction of winds (air masses) at various altitudes. (WI)
Barium Ion Cloud (GRS-B)	Scout	L: 9/20/71	Joint NASA/German effort to study the broad features of electric and magnetic fields in the outer radiation belt by optical investigation of the behavior of a barium ion cloud released at several Earth radii altitude. Vehicle provided by NASA on non-reimbursable basis. (WI)
OSO 7	Delta	L: 9/29/71 D: 7/9/74	To observe the active physical processes on the Sun by which the Sun influences the Earth and its space environment; and to advance our understanding of the Sun's constitution and behavior.
ITOS B	Delta	L: 10/21/71	To provide improved operational infrared and visual observations of Earth cloud cover for use in weather analysis and forecasting. NASA reimbursed by NOAA for both spacecraft and launch support. Mission failure due to vehicle second stage malfunction.(Reimbursable)(WTR)
Explorer 45 (SSS-A)	Scout	L: 11/15/71	Investigate the ring-current and magnetic storms; relations between auroral phenomena, magnetic storms and the acceleration of charged particles within the inner magnetosphere; and time variations of the particle population. (SM)

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Mission	Vehicle	Date	Mission/Remarks
UK 4 (United Kingdom)	Scout	L: 12/11/71	Investigate interactions among the plasma, charged particle streams and electromagnetic waves in the upper ionosphere. (International Cooperative) (WTR)
Intelsat IV F-3	Atlas Centaur	L: 12/19/71	Global commercial communications satellite system. (Comsat reimbursable)
		1972	
Intelsat IV F-4	Atlas Centaur	L: 1/22/72	Global commercial communications satellite system. (Comsat reimbursable)
HEOS A-2	Delta	L: 1/31/72 D: 8/2/74	Investigation of interplanetary space and of the high altitude magnetosphere and its boundary in the region around the northern neutral point. (ESRO Reimbursable)
Pioneer 10	Atlas Centaur	L: 3/3/72	Investigation of the interplanetary medium; the nature of asteroid belt; and the exploration of Jupiter and its environment.
TD 1 (ESRO)	Thor Delta	L: 3/12/72	NASA responsible for placing satellite in an Earth orbit for ESRO. Seven scientific experiments aboard the spacecraft. (Reimbursable)
Apollo 16 (AS-511/ CSM-113/ LM-11)	Saturn V	L: 4/16/72 D: 4/27/72	Fifth manned lunar landing; second of Apollo J series carrying the LRV. Astronauts: John W. Young, Thomas K. Mattingly II and Charles M. Duke. Total flight time 265 hours 51 minutes. Total EVA time 20 hours 14 minutes. Mattingly's in-flight EVA 1 hour 24 minutes. Splashdown in Pacific. Returned 213 lbs. lunar material.

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Mission	Vehicle	Date	Mission/Remarks
Intelsat IV F-5	Atlas Centaur	L: 6/13/72	Global commercial communications satellite system. (Comsat Reimbursable)
ERTS 1 (now Landsat)	Delta	L: 7/23/72	Acquire synoptic, multispectral repetitive images to investigate disciplines, i.e., agriculture, forestry, mineral and land resources, map and chart. (WTR)
Explorer 46 (MTS)	Scout	L: 8/13/72	Measure the meteoroid penetration rates in a bumper protected target and to obtain meteoroid velocity and impact flux data. (WI)
OAO 3 Copernicus	Atlas Centaur	L: 8/21/72	Obtain precise astronomical observations of celestial objects from above the Earth's atmosphere so that new and fundamental knowledge about the universe may be acquired.
Transit (INS-1)	Scout	L: 9/2/72	U.S. Navy Navigation Satellite.(Reimbursable) (WTR)
Explorer 47 (IMP-H)	Delta	L: 9/22/72	Study cislunar radiation environment over significant portion of solar cycle, interplanetary magnetic field and Earth's magnetosphere.
NOAA 2 (ITOS-D) AMSAT-OSCAR 6	Delta	L: 10/15/72	Operational meteorological satellite based on Tiros research and development experience. A small communications relay satellite (AMSAT-OSCAR-6) designed to operate in the radio amateur frequency bands carried as a piggyback. Design life of A-O-6 at least one year of successful operation in orbit. (Reimbursable)

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Mission	Vehicle	Date	Mission/Remarks
Telesat A (ANIK)	Delta	L: 11/9/72	First of series of Canadian Domestic Communications Satellites. Designed to provide transmission of television, voice, data, etc., throughout Canada. (Reimbursable)
Explorer 48 (SAS-B)	Scout	L: 11/16/72	Perform sky survey of high energy gamma radiation from the celestial spheres, to determine the extent of primary galactic gamma radiation and to ascertain the presence of gamma ray point sources. (SM)
ESRO IV	Scout	L: 11/21/72 D: 4/15/74	Investigate and measure several phenomena in polar ionosphere. (Reimbursable) (WTR)
Apollo 17 (AS-512/ CSM-114/ LM-12)	Saturn V	L: 12/7/72 D: 12/19/72	Sixth and last manned lunar landing; third of Apollo J series carrying lunar rover. Astronauts: Eugene A. Cernan, Ronald E. Evans and Harrison H. Schmitt; spent 301 hours 52 minutes in flight. Cernan and Schmitt during the three EVAs completed a total of 22 hours 4 minutes each. Returned 243 lbs. lunar samples.
Nimbus 5	Delta	L: 12/11/72	Stabilized Earth-oriented platform for testing of advanced systems, sensing and collecting meteorological and geological data.
AEROS 2 (German)	Scout	L: 12/16/72 D: 8/22/73	Study the state and behavior of upper atmosphere and ionospheric F region, especially with regard to influence of solar ultraviolet radiation. (International Cooperative) (WTR)

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Mission	Vehicle	Date	Mission/Remarks
		1973	
Pioneer 11	Atlas Centaur	L: 4/6/73	Obtain precursory scientific information beyond the orbit of Mars with emphasis on investigation of interplanetary medium; investigation of nature of the asteroid belt; and exploration of Jupiter and its environment.
Telesat B (ANIK 2)	Delta	L: 4/20/73	Second of series of Canadian Domestic Communications Satellites. Designed to transmit TV, voice, data. (Reimbursable)
Skylab 1 (Workshop) (513/SIVB-212)	Saturn V	L: 5/14/73	Unmanned: Spacecraft comprised of Orbital Workshop, Airlock Module, Multiple Docking Adapter, Apollo Telescope Mount, Instrument Unit and Payload Shroud.
Skylab 2 (206/CSM-116)	Saturn IB	L: 5/25/73 D: 6/22/73	First Manned Skylab launch. Crew: Charles Conrad, Jr., Joseph P. Kerwin and Paul J. Weitz. Objectives: Establish Skylab Orbital Assembly in Earth orbit; conduct series of medical experiments associated with the extension of manned space flight. Recovered SL-2 from Pacific 38.5 minutes after splashdown. Mission duration: 28 days, 49 minutes 49 seconds. Data obtained on 46 of 55 experiments. Crew performed 3 EVAs totaling 5 hours 41 minutes.
Explorer 49 (Radio Astronomy Explorer-B)	Delta	L: 6/10/73	Make measurements of galactic and solar radio noise at frequencies below ionospheric cutoffs and external to terrestrial background interference by utilization of the Moon for occultation, focusing or aperture blocking for increased resolution and discrimination.

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Mission	Vehicle	Date	Mission/Remarks
ITOS E (NOAA)	Delta	L: 7/16/73 D: 7/16/73	Operational meteorological satellite to obtain global cloud cover data both day and night for use in weather analysis and forecasting. NASA reimbursed by NOAA for both spacecraft and launch support. Mission failed due to vehicle second stage malfunction. (WTR)
Skylab 3 (207/CSM-117)	Saturn IB	L: 7/28/73 D: 9/25/73	Second Manned Skylab launch. Crew: Alan L. Bean, Owen K. Garriott and Jack R. Lousma. Crew performed systems and operational tests, assigned experiments and thermal shield deployment. SL-3 recovered from Pacific Ocean 43 minutes after splashdown. Mission duration: 59 days 11 hours 9 minutes 4 seconds. Crew performed 3 EVAs totaling 13 hours 44 minutes.
Intelsat IV F-7	Atlas Centaur	L: 8/23/73	Global Commercial communications satellite system. (Comsat reimbursable)
Explorer 50 (IMP-J)	Delta	L: 10/25/73	Perform detailed and near continuous studies of interplanetary environment for orbital periods comparable to several rotations of active solar regions; and to study particle and field interactions in the distant magnetotail including cross sectional mapping of the tail and neutral sheet.
Transit (NNSS/0-20)	Scout	L: 10/30/73	U.S. Navy Navigation Satellite.(Reimbursable) (WTR)

Mission	Vehicle	Date	Mission/Remarks
NOAA 3 (ITOS-F)	Delta	L: 11/6/73	Operational Meteorological Satellite to obtain global cloud cover data both day and night for use in weather analysis and forecasting. NASA reimbursed by NOAA for both spacecraft and launch support. (Reimbursable) (WTR)
Skylab 4 (208/CSM-118)	Saturn IB	L: 11/16/73 D: 2/8/74	Third Manned Skylab launch. Crew: Gerald Carr, Edward Gibson and William Pogue. Performed unmanned Saturn Workshop operations; reactivate Skylab orbital assembly in Earth orbit; obtain medical data on crew for use in extending the duration of manned space flights; performed inflight experiments. SL-4 recovered from Pacific Ocean approximately 40 minutes after splashdown. Mission duration: 84 days 1 hour 16 minutes. Crew performed 4 EVAs totaling 22 hours 21 minutes.
Explorer 51 (Atmosphere Explorer-C)	Delta	L: 12/16/73	Investigate the photochemical processes accompanying the absorption of solar ultraviolet radiation in Earth's atmosphere by making closely coordinated measurements of reacting constituents from spacecraft with onboard propulsion to permit perigee and apogee altitudes to be varied by command.
		1974	
Skynet II-A	Delta	L: 1/18/74	United Kingdom Communications Satellite. Vehicle failed due to short circuit in the electronics package of the vehicle. (Reimbursable)

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Mission	Vehicle	Date	Mission/Remarks
Centaur Proof	Titan III E Centaur	L: 2/11/74 D: 2/11/74	Demonstrate the capability of the Titan III E Centaur D-IT launch vehicle, the Centaur Standard Shroud and the ability of the Integrate, Transfer Launch Facility to support operational Titan/ Centaur missions. (Vehicle failure.)
San Marco 4	Scout	L: 2/18/74 D: 5/4/76	Obtain measurements of the diurnal variations of the equatorial neutral atmosphere density, composition and temperature. (International Cooperative) (SM)
UK X4	Scout	L: 3/8/74	Demonstrate an accuracy of better than 3 arc minutes using a gas jet system;to measure the performance in orbit of components of an operational infrared sensor; to check photometric calibration of the sensor to measure the density of Sun-reflecting particles near the spacecraft.(Reimbursable) (WTR)
WESTAR A (Western Union)	Delta	L: 4/13/74	Domestic communications satellite to provide transmission of communications throughout the USA. (Reimbursable)
SMS 1	Delta	L: 5/17/74	Part of a global network of geostationary environmental satellites with the objective of providing Earth imaging in the visible and IR spectrum, monitoring space environment.
ATS 6	Titan III C	L: 5/30/74	Applications Technology Satellite to provide a large antenna structure capable of providing good quality TV signal to small, inexpensive ground receivers.

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Mission	Vehicle	Date	Mission/Remarks
Explorer 52 (Hawkeye)	Scout	L: 6/3/74	Study the plasma properties of the magnetosphere in the vicinity of the magnetic neutral point over the Earth's north polar cap (WTR)
AEROS 2	Scout	L: 7/16/74 D: 9/25/75	Measure the main aeronomic parameters determining the state of the upper atmosphere and the solar ultraviolet radiation in the wavelength band of main absorption. (German reimbursable) (WTR)
ANS 1	Scout	L: 8/30/74 D: 6/14/77	Obtain spectral distribution and other data from celestial X-ray and ultraviolet sources; cooperative with the Netherlands. (WTR)
WESTAR 2	Delta	L: 10/10/74	Domestic communications satellite. Reimbursed and operated by Western Union.
UK 5 (AERIEL 5)	Scout	L: 10/15/74	Investigate galactic and extragalactic X-ray sources. (International Cooperative) (SM)
NOAA 4 (ITOS-G) INTASAT	Delta	L: 11/15/74	Meteorological satellite: Constructed and launched by NASA. Reimbursed and operated by NOAA. INTASAT: Carried piggyback on ITOS-G to measure total electron content, ionospheric irregularities and ionospheric scintillations. Cooperative with Spain. (WTR)
Intelsat IV F-8	Atlas Centaur	L: 11/21/74	Communications satellite: Reimbursed and operated by Comsat to expand the global satellite system.

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Mission	Vehicle	Date	Mission/Remarks
Skynet II-B	Delta	L: 11/22/74	Communications satellite: United Kingdom reimbursable to provide X-band military communications.
Helios A	Titan III-E Centaur	L: 12/10/74	Scientific satellite to investigate the properties of and processes in interplanetary space in the direction of and close to the Sun. Cooperative with West Germany.
Symphonie A	Delta	L: 12/17/74	Communications satellite: Joint project by France and Germany to provide communications to Europe, Africa and South America. (Reimbursable)

Mission	Vehicle	Date	Mission/Remarks
		1975	
Landsat 2 (Formerly ERTS)	Delta	L: 1/22/75	Second Earth Resources Technology Satellite to locate, map and measure Earth resources parameters from space and demonstrate the applicability of this approach to the management of the world's resources. (WTR)
SMS 2	Delta	L: 2/6/75	Second developmental meteorological satellite to provide continuous observation of environmental phenomena and help develop an environmental network for routine observations and early warning.
Intelsat IV F-6	Atlas Centaur	L: 2/20/75	Vehicle failure - Comsat Communications Satellite. (Reimbursable)
GEOS 3	Delta	L: 4/9/75	Oceanographic and geodetic satellite to measure ocean topography, sea state and other features of the Earth. (WTR)
Explorer 53 (SAS-C)	Scout	L: 5/7/75	Scientific satellite to search for sources radiating in the X-ray, gamma ray, ultraviolet, and other spectral regions both inside and beyond our galaxy. (SM)
Telesat C (ANIK3)	Delta	L: 5/7/75	Canadian Domestic Communications Satellite. (Reimbursable)
Intelsat IV F-1	Atlas Centaur	L: 5/22/75	Comsat Communications Satellite. (Reimbursable)
Nimbus 6	Delta	L: 6/12/75	Meteorological Satellite - R&D of instruments for expanding capabilities for remote sensing of the atmosphere. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
OSO 1	Delta	L: 6/21/75	Scientific satellite to study specific features of the Sun.
Apollo Soyuz Test Project	Saturn 1B	L: 7/15/75 D: 7/24/75	Apollo Soyuz Test Project (ASTP). Manned: Thomas P. Stafford, Vance D. Brand and Donald K. Slayton. Docked with Soyuz 19 on 7/17/75. Mission duration 217 hrs., 28 mins.
COS-B	Delta	L: 8/8/75	Cosmic Ray Satellite to study extraterrestrial gamma radiation. Launched for the European Space Agency. (Reimbursable) (WTR)
Viking 1	Titan III Centaur	L: 8/20/75 D: 7/20/76 (Lander)	Scientific investigation of Mars. United States' first attempt to soft land a spacecraft on another planet. Successfully soft landed on 7/20/76. First in situ analysis of surface material on another planet.
Symphonie-B	Delta	L: 8/26/75	Communications satellite. French/German cooperative. (Reimbursable)
Viking 2	Titan III Centaur	L: 9/9/75 D: 9/3/76 (Lander)	Scientific investigation of Mars. United States' second attempt to soft land on Mars. Successfully soft landed on 9/3/76. Successfully returned scientific data.
Intelsat IVA F-1	Atlas Centaur	L: 9/25/75	First in a series of improved Comsat Communications Satellites. Double the capacity of previous Intelsats. (Reimbursable)
Explorer 54 AE-D	Delta	L: 10/6/75 D: 3/12/76	Scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
U. S. Navy	Scout	L: 10/12/75	Navy Transit Navigation Satellite (Reimbursable) (WTR)
GOES A (SMS-C)	Delta	L: 10/16/75	Geostationary Operational Environmental Satellite. Constructed and launched by NASA. Funded and reimbursed by NOAA.
Explorer 55 (AE-E)	Delta	L: 11/20/75	Scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.
DAD-A/B	Scout	L: 12/5/75	Scientific satellite to measure global density of upper atmosphere and lower exosphere - vehicle failed. (WTR)
RCA-A	Delta	L: 12/13/75	Communications satellite. First RCA Domestic Communications Satellite. (Reimbursable)
		1976	
Helios 2	Titan III Centaur	L: 1/15/76	Scientific satellite to investigate the properties in interplanetary space close to the Sun. Cooperative with Germany.
CTS	Delta	L: 1/17/76	Experimental High Powered Communications Satellite. Cooperative with Canada.
Intelsat IVA F-2	Atlas Centaur	L: 1/29/76	Comsat Communications Satellite. (Reimbursable)
Marisat-A	Delta	L: 2/19/76	Comsat Maritime Communications Satellite. (Reimbursable)
RCA-B	Delta	L: 3/26/76	Second RCA (Satcom) Domestic Communications Satellite. (Reimbursable)

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Mission	Vehicle	Date	Mission/Remarks
NATO-III A	Delta	L: 4/22/76	Communications Satellite for the North Atlantic Treaty Organization. (Reimbursable)
LAGEOS	Delta	L: 5/4/76	To demonstrate the feasibility and utility of a ground-to-satellite laser system to contribute to the study of solid-Earth dynamics. (WTR)
Comstar-IA	Atlas Centaur	L: 5/13/76	Comsat's first Domestic Communications Satellite. (Reimbursable)
Air Force Test	Scout	L: 5/22/76	To evaluate certain propagation effects of disturbed plasmas on radar and communications systems. (Reimbursable) (WTR)
Marisat-B	Delta	L: 6/9/76	Comsat Maritime Communications Satellite. (Reimbursable)
Gravity Probe-A	Scout	L: 6/18/76	Scientific probe to test Einstein's Theory of Relativity. (WI)
Palapa-A	Delta	L: 7/8/76	Indonesian Communications Satellite. (Reimbursable)
Comstar-B	Atlas Centaur	L: 7/22/76	Comsat's second Domestic Communications Satellite. (Reimbursable)
ITOS-H	Delta	L: 7/29/76	Meteorological Satellite - redesignated NOAA-5. (Reimbursable) (WTR)
U. S. Navy TIP 3	Scout	L: 9/1/76	Transit Improvement Program (TIP). U. S. Navy Navigation Satellite. (Reimbursable) (WTR)
Marisat-C	Delta	L: 10/14/76	Comsat Maritime Communications Satellite. (Reimbursable)

Mission	Vehicle	Date	Mission/Remarks
		1977	
NATO III B	Delta	L: 1/27/77	NATO Communications Satellite. (Reimbursable)
Palapa-B	Delta	L: 3/10/77	Indonesian Communications Satellite. (Reimbursable)
GEOS/ESA	Delta	L: 4/20/77	ESA Scientific Satellite to investigate waves and particles in the magnetosphere. Rated unsuccessful by NASA. (Reimbursable)
Intelsat IVA F-4	Atlas Centaur	L: 5/26/77	Comsat Communications Satellite. (Reimbursable)
GOES/NOAA	Delta	L: 6/16/77	Geostationary Operational Environmental Satellite. Second in a series launched for NOAA. (Reimbursable)
GMS/Japan	Delta	L: 7/14/77	Geostationary Meteorological Satellite. First GMS launched for Japan. (Reimbursable)
HEAO-A	Atlas Centaur	L: 8/12/77	Scientific Satellite - High Energy Astronomy Observatory to study and map X-rays and gamma rays.
Voyager 2	Titan III Centaur	L: 8/20/77	Scientific Satellite to study Jupiter and Saturn planetary systems including their satellites and Saturn's rings.
SIRIO/Italy	Delta	L: 8/25/77	Scientific Satellite - Italian project to investigate trapped radiation flux, magnetic field intensity and variation, and the primary electron energy spectrum. (Reimbursable)
Voyager 1	Titan III Centaur	L: 9/5/77	Scientific Satellite - second Voyager launched to investigate Jupiter and Saturn Planetary Systems.

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Mission	Vehicle	Date	Mission/Remarks
OTS/ESA	Delta	L: 9/13/77	Orbital Test Satellite. ESA experimental communications satellite. Vehicle failure. (Reimbursable)
Intelsat IVA F-5	Atlas Centaur	L: 9/29/77	Comsat Communications Satellite. Vehicle failure. (Reimbursable)
ISEE-A/B	Delta	L: 10/22/77	International Sun-Earth Explorer. Joint NASA/ESA mission to study the interaction of the interplanetary medium with Earth's immediate environment - dual payload. Cooperative.
Navy Transat	Scout	L: 10/28/77	U. S. Navy Navigation Satellite. (Reimbursable) (WTR)
Meteosat (ESA)	Delta	L: 11/22/77	ESA Meteorological Satellite. Europe's contribution to the Global Atmospheric Research Program (GARP). (Reimbursable)
CS/Japan	Delta	L: 12/14/77	Communications Satellite. Launched for Japan. (Reimbursable)
		1978	
Intelsat IVA	Atlas Centaur	L: 1/6/78	Comsat Communications Satellite. (Reimbursable)
IUE 1	Delta	L: 1/26/78	International Ultraviolet Explorer in cooperation with the European Space Agency and the British Science Research Council. (Reimbursable)
FLTSATCOM 1	Atlas Centaur	L: 2/9/78	Fleet communications for U.S. Navy; first in a series. (Reimbursable)
Landsat 3	Delta	L: 3/5/78	Ecological data satellite, joins Landsats 1 and 2 in cataloging Earth's resources and monitoring changing environmental conditions. (WTR)

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Mission	Vehicle	Date	Mission/Remarks
Intelsat IV-A F-6	Atlas Centaur	L: 3/31/78	Comsat Communications Satellite. (Reimbursable)
Japan/BSE	Delta	L: 4/7/78	Experimental broadcasting satellite for research. (Reimbursable)
HCMM	Scout	L: 4/26/78	Heat Capacity Mapping Mission to produce thermal maps of atmosphere. (WTR)
OTS	Delta	L: 5/11/78	Backup European Space Agency Orbital Test Satellite. (Reimbursable)
Pioneer Venus 1	Atlas Centaur	L: 5/20/78	Planetary mission to Venus, studies of solar wind.
GOES 3	Delta	L: 6/16/78	Geostationary Environmental Satellite for Earth imaging. (NOAA Reimbursable)
Seasat 1	Atlas F	L: 6/26/78	Sea satellite for global ocean monitoring. (WTR)
Comstar D-3	Atlas Centaur	L: 6/29/78	Third in a series of domestic communications satellites. (Comsat Reimbursable)
GEOS 3	Delta	L: 7/14/78	ESA spacecraft to study atmospheric radiation particles. (Reimbursable)
Pioneer Venus 2	Atlas Centaur	L: 8/8/78	Venus multiprobe mission to study planet's atmosphere.
ISEE 3	Delta	L: 8/12/78	International Sun Earth Explorer. Earth "halo" orbit.

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NASA ANNIVERSARY FILLERS

WASHINGTON, D.C. -- Over 60 billion dollars have been invested by the U.S. in civil aeronautics and space research through 1977.

WASHINGTON, D.C. -- The cargo compartment of NASA's Space Shuttle, reusable space transportation system of the 1980s, can accommodate up to 29,500 kilograms (64,960 lb.) of cargo space and passengers.

WASHINGTON, D.C. -- Two former astronauts are now United States Senators: John Glenn of Ohio and Harrison Schmitt of New Mexico.

WASHINGTON, D.C. -- NASA's Space Shuttle, which will be in operation in the 1980s, corresponds in size to a DC-9 commercial jetliner.

WASHINGTON, D.C. -- Using technology developed for the lunar landing vehicle used on the Moon, an automated guidance and control system is being applied to a coal mining machine. The machine will make coal mining safer, more productive and more economical.

HAMPTON, Va. -- Langley Research Center in Hampton, Va., is the oldest of all the NASA Centers.

WASHINGTON, D.C. -- Existence of the Van Allen Belts was confirmed in 1958 by Explorer I and Pioneer III.

WASHINGTON, D.C. -- Senator Lyndon B. Johnson was one of the sponsors of the Senate bill to create a National Aeronautics and Space Administration in April 1958.

WASHINGTON, D.C. -- NASA films have won some 225 different awards and honors.

WASHINGTON, D.C. -- The international space program involves more than 80 nations.

WASHINGTON, D.C. -- In April 1975, GEOS-3 became the first satellite to track another satellite.

WASHINGTON, D.C. -- Pioneer 10 launched May 1972, will be the first man-made object to escape the solar system, sometime in mid 1980s.

WASHINGTON, D.C. -- Gerald Carr, Dr. Edward Gibson and William Pogue have spent more time in space than any other U.S. astronauts -- 2,017 hours and 16 minutes. John Glenn has spent the least amount of time in space -- hours and 55 minutes.

WASHINGTON, D.C. -- NASA tracking networks support some 60 individual flight missions a year.

HUNTSVILLE, Ala. -- NASA's Marshall Space Flight Center developed a management method for Research and Development programs which is being successfully employed by the Upjohn Co. of Kalamazoo, Michigan. They report substantial person-hours and cost savings.

WASHINGTON, D.C. -- NASA has successfully launched some 350 space vehicles.

-end-

NASA News

National Aeronautics and
Space Administration

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For Release
IMMEDIATE

RELEASE NO: 78-150

CHAIRMAN TEAGUE AWARDED NASA MEDAL

Rep. Olin E. Teague (D.-Texas) was awarded NASA's Distinguished Public Service Medal, Oct. 3, at an outdoor ceremony at NASA Headquarters, Washington, D.C. Teague is Chairman of the House Committee on Science and Technology.

NASA Administrator Robert A. Frosch lauded Teague's efforts in behalf of NASA and the U.S. space program saying: "For us at NASA, Chairman Teague's most outstanding asset has been his consistent and unswerving faith in the value and virtue of a dynamic and imaginative space program -- a faith which he has conveyed to all the elements of the government, industry and university team on which all progress in space depends.

- more -

Mailed:
October 5, 1978

"The single episode which best epitomizes Mr. Teague's profound faith in the space effort, was the leadership he demonstrated at the time of the Apollo fire in early 1967.... Undoubtedly, more than any other single individual, Chairman Teague saved the program and redirected our energies in a direction which resulted in the successful lunar landing within the decade of the '60s."

The citation accompanying Teague's medal award reads:

"In recognition of his distinguished contributions to the scientific and technological advancement of the nation by his steadfast advocacy of a strong national space program. In two decades of leadership positions in the House of Representatives, he gained the continuing support of the Congress for the cause of building and maintaining the spacefaring capabilities of the United States."

Teague is retiring from Congress after his present term, following more than 30 years of service as a member of the House of Representatives.

Guests attending the ceremony included Mrs. Teague; James E. Webb, former administrator of NASA; Rep. Don Fuqua (D.-Fla.), chairman of the House Subcommittee on Space Science and Applications; and Astronaut Alan B. Shepard, Jr., a Congressional Space Medal of Honor winner.

- end -

NASA News

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Washington, D.C. 20546
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For Release

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RELEASE NO: 78-151

NASA, DOE SELECT 10 CONTRACTORS TO IMPROVE SOLAR CELL PRODUCTION METHODS

Ten companies have been selected to begin contract negotiations for projects to improve current methods of manufacturing modules of photovoltaic cells.

Photovoltaic cells, also called solar cells, are crystalline wafers which convert sunlight directly to electricity with no inherently energy-wasting steps in between.

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Mailed:
October 10, 1978

The goal of the $4 million effort, announced by the Department of Energy (DOE), Washington, D.C., and NASA's Jet Propulsion Laboratory, Pasadena, Calif., is to focus on improved methods of production which will lead to cost reductions in the 1979-1981 period. This work supplements current program efforts aimed toward DOE's 1986 goal of less than $0.50 a watt (1975 dollars), a cost which would make photovoltaic energy economically competitive with conventional power sources.

The 10 firms are: Arco Solar, Inc., Chatsworth, Calif.; Energy Materials Corp., Ayer, Mass.; Kayex Corp., Rochester, N.Y.; Kluicke & Soffa Industries, Inc., Horshan, Pa.; MB Associates, San Ramon, Calif.; Motorola, Inc., Semiconductor Group, Phoenix, Ariz.; RCA Corp., David Sarnoff Research Center, Princeton, N.J.; Sensor Technology, Inc., Chatsworth, Calif.; Siltec Corp., Menlo Park, Calif.; and Sollos, Inc., Los Angeles, Calif.

Projects to be undertaken by the firms will focus on better means of mass-producing large modules of silicon-based photovoltaic cells. The 10 winning companies were selected on the basis that the new techniques proposed could be applied widely to industries producing flat (or non-concentrating) photovoltaic modules in the 1979-1981 time period.

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The projects involve techniques which can be applied to the entire range of production steps, from raw materials to final modules. Examples of work to be done once contracts are signed include novel techniques for slicing the silicon solar cell material and improvements in ways to assemble the photovoltaic modules.

Solar cells produced by methods developed in this project must have a life expectancy longer than 20 years and the capability of converting more than 10 per cent of the incident sunlight into electricity.

NASA's JPL manages the project, designated the "Low Cost Solar Array Project," for DOE. JPL is operated for NASA by the California Institute of Technology. Six of the 10 companies are small businesses and will receive about 50 per cent of the funding. The 10 were selected from 33 proposers.

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NASA Fact Sheet

National
Aeronautics and
Space
Administration

For Release:

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IMMEDIATE

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Release No: 78-152

STATUS OF VOYAGER SPACECRAFT, OCTOBER 1, 1978

		Voyager 1	Voyager 2
Spacecraft distance from Earth	km	704,692,000	668,582,000
	mi	437,875,000	415,437,000
Spacecraft distance to Jupiter	km	150,983,000	201,354,000
	mi	93,816,000	125,117,000
Spacecraft distance to Saturn	km	959,062,000	958,804,000
	mi	595,934,000	595,772,000
Spacecraft distance traveled since launch	km	816,533,000	831,435,000
	mi	507,370,000	516,630,000
Spacecraft velocity Relative to Earth	km/sec	24.87	27.10
	mi/hr	55,632	60,620
Spacecraft velocity Relative to Sun	km/sec	15.43	14.18
		34,514	31,727

Mailed:
October 6, 1978

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
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For Release

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RELEASE NO: 78-153

VENUS-BOUND CRAFT PASS CRITICAL TESTS

The two Pioneer spacecraft enroute to Venus -- the orbiter and the multiprobe -- have passed major planet operations tests.

Aboard the multiprobe spacecraft, Pioneer Venus 2, orientation, timing and separation systems have been tested for the split-second release of three probes which will spread over Venus' Earth-facing hemisphere, 9,600 kilometers (6,000 miles) apart.

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Mailed:
October 10, 1978

On the orbiter spacecraft, Pioneer Venus 1, systems for the essential retrofire and injection-into-orbit maneuver (which takes place behind the planet and out of communication with the Earth) have been operated or tested.

The separate operations teams for the two spacecraft at NASA's Ames Research Center, Mountain View, Calif., have sent 6,400 commands to the orbiter since launch on May 20 -- and 3,600 commands to the multiprobe craft since its Aug. 8 launch. Twenty days and 13 million km (8 million mi.) from the planet the multiprobe splits into the transporter bus and four probes. The bus itself becomes a fifth probe.

The multiprobe now has covered 140 million km (87 million mi.) on its 325 million km (200 million mi.) flight path to Venus. The orbiter has covered 325 million km (202 million mi.) of its longer 500 million km (310 million mi.) flight path. Both spacecraft still have about 180 million km (112 million mi.) to travel before reaching Venus. The orbiter arrives Dec. 4, the craft with five entry probes Dec. 9.

The two Pioneers and their 30 experiments are expected to improve understanding of Venus' simple weather machine, and this in turn should help us to better understand the forces that drive Earth's weather.

Virtually all experiments and systems on each of the five entry craft of the multiprobe now have been operated and are working well. These include thermal, orientation, command, communications and data return and power systems -- as well as separation systems for the 90-kilogram (200-pound) smaller probes.

This critical separation will allow launch from the spinning transporter bus of three of the entry probes at precise positions in space and within milliseconds of each other, sending them to carefully selected atmospheric entry points on Venus.

The three probes separate from the bus Nov. 19 and enter the atmosphere Dec. 9. They are known as the north, day and night probes. The day probe will enter Venus' southern hemisphere on the planet's day side, the night probe will enter the night southern hemisphere and the north probe will enter the North Polar Vortex, also on Venus' night side.

Controllers at Ames are also well along with operations for separation of a fourth probe, the large 300-kg (700-lb.) sounder probe from the transporter bus Nov. 15, four days before smaller probe separation.

Navigation maneuvers enabling the sounder probe to enter Venus' atmosphere near the equator on the day side also have been tested, as have those for bus entry in the day side southern hemisphere.

On the orbiter spacecraft, all instruments have been checked and calibrated. Most of the orbiter operations systems have been tested and are in good shape, including systems for insertion of the orbiter into orbit Dec. 4.

The six orbiter interplanetary instruments are gathering data during the current period of mounting solar activity. On Sept. 23, they measured high solar wind speeds and other phenomena from a major storm on the Sun. The orbiter's "camera" instruments, the cloud photopolarimeter, will begin measuring light from Venus Tuesday, Oct. 10. It will return the first pictures of Venus on its second orbit Dec. 5.

The orbiter will be placed in its 24-hour orbit around Venus by a 30-second burn of its 17,790-newton (4,000-lb.)-thrust rocket engine. This will reduce velocity by 3,953 kilometers per hour (2,456 miles per hour). A detailed final test of the orbital injection sequence is planned Oct. 30.

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The numerous events of the complicated orbital maneuver, which immediately follows the orbital rocket burn, were successfully simulated in detail Sept. 19. Controllers plan a second orbit operations test Oct. 17.

On Oct. 4, controllers successfully completed the first test of the X-band radio system in conjunction with the regular S-band system of the orbiter. Comparisons of X- and S-band frequencies will allow scientists to make more exact radio studies of Venus' atmosphere when the orbiter passes behind the planet.

On Oct. 6, multiprobe controllers were scheduled to conduct further tests of instruments on the large sounder probe, and Oct. 12, probe mission operations with the Deep Space Network stations in Spain, Australia and California will be tested. On Oct. 19, controllers will turn the multiprobe 90 degrees so that its aft-mounted medium-gain horn antenna faces Earth. This antenna will be used during the difficult probe separation maneuvers.

On Oct. 12, controllers will do an entry operations test, and Oct. 31, a final sounder probe navigation test. They also have tested probe experiments during simulations of the communications blackout during atmosphere entry.

On Oct. 6, the orbiter was 34.4 million km (21.4 million mi.) from Earth, traveling away from Earth at 7,580 km/hr (4,700 mph). The multiprobe was 13.5 million km (8.4 million mi.) from Earth, traveling at 10,630 km/hr (6,600 mph).

The Pioneer project is managed for NASA by Ames. The spacecraft are built by Hughes Aircraft Co., El Segundo, Calif.

-end-

LH-14

NASA FactSheet

National
Aeronautics and
Space
Administration

For Release:

IMMEDIATE

Nicholas Panagakos
Headquarters, Washington, DC
(Phone: 202/755-3680)

Frank Bristow
NASA Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 213/354-5011)

RELEASE NO: 78-154

STATUS OF VOYAGER SPACECRAFT, OCTOBER 5, 1978

		Voyager 1	Voyager 2
Spacecraft distance from Earth	km	704,692,000	668,582,000
	mi	437,875,000	415,437,000
Spacecraft distance to Jupiter	km	105,983,000	201,354,000
	mi	93,816,000	125,117,000
Spacecraft distance to Saturn	km	959,062,000	958,804,000
	mi	595,934,000	595,772,000
Spacecraft distance traveled since launch	km	816,533,000	831,435,000
	mi	507,370,000	516,630,000
Spacecraft velocity Relative to Earth	km/sec	24.87	27.10
	mi/hr	55,632	60,620
Spacecraft velocity Relative to Sun	km/sec	15.43	14.18
	mi/hr	34,514	31,727
Date of Jupiter Encounter (closest approach)		March 5, 1979	July 9, 1979
Date of Saturn Encounter (closest approach)		Nov. 12, 1980	Aug. 27, 1981

Mailed:
October 11, 1978

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 755-8370

For Release

IMMEDIATE

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(Phone: 202/755-2070)

Don Finley
U.S. Geological Survey, Reston, Va.
(Phone: 703/860-7444)

RELEASE NO: 78-155

DAVID S. JOHNSON RECEIVES 1978 PECORA REMOTE SENSING AWARD

David S. Johnson, director of the National Environmental Satellite Service (NESS) in the Department of Commerce, has been awarded the 1978 William T. Pecora Award for his work in applying satellite remote sensing to monitoring the weather and the environment.

The award has been presented annually since 1974 by the Department of the Interior and NASA to honor outstanding contributions by individuals and organizations in the field of remote sensing.

-more-

Mailed:
October 13, 1978

Johnson, 54, was presented the 1978 award by Robert Herbst, Assistant Secretary of the Interior for Fish and Wildlife and Parks, at a banquet Oct. 11 in Sioux Falls, S.D., as part of the Fourth Annual William T. Pecora Memorial Symposium on remote sensing.

Dr. Pecora, who died in 1972, was Undersecretary of the Interior and earlier was Director of the U.S. Geological Survey. He was a motivating force in the development of NASA's Landsat Earth resources survey satellite program and in the establishment of the Interior Department's EROS (Earth Resources Observation Systems) program managed by the USGS.

The 1978 award citation says Johnson "has devoted a major portion of his scientific and managerial life to the development and implementation of remote sensing systems designed to observe weather patterns, impacts of weather and man on our environment, the climatological trends of the Earth, and in the process eliminated or alleviated loss of property and life as a result of natural disasters."

Johnson lives in Oxon Hill, Md., with his wife, Margaret.

-end-

NOTE TO EDITORS: Glossy prints of Johnson are available to news media from the Information Office, U.S. Geological Survey, 119 National Center, Reston, Va. 22092, Telephone 703/860-7444.

NASA News

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For Release:

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IMMEDIATE

RELEASE NO: 78-156

SEASAT CEASES TRANSMITTING SIGNALS

The Seasat, NASA's experimental ocean monitoring satellite, stopped transmitting data shortly after midnight EDT Tuesday, October 10, while the spacecraft was over Australia.

Scientists and engineers at NASA's Goddard Space Flight Center, Greenbelt, Md., and Jet Propulsion Laboratory, Pasadena, Calif., are working with Lockheed Missiles and Space Co., Sunnyvale, Calif., engineers to determine the cause of the malfunction.

Seasat 1, an ocean-monitoring, polar orbit spacecraft was launched June 26 from the Western Test Range, near Lompoc, Calif.

-end-

Mailed:
October 11, 1978

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For Release

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IMMEDIATE

Jim Lacy
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/982-4955)

RELEASE NO: 78-157

SPACE TRACKING SHIP VANGUARD TRANSFERRED TO NEW ASSIGNMENT

After 12 years of supporting Apollo, Skylab and Apollo Soyuz manned space flight missions, the USNS Vanguard, last of an original five-ship tracking and reentry coverage flotilla, was transferred Oct. 1 to the United States Navy for navigational and ocean survey work.

Vanguard served NASA astronauts throughout 10 Apollo, four Skylab and one Apollo Soyuz mission as a floating tracking station carrying out assignments in the Atlantic, Indian and Pacific Oceans.

-more-

Mailed:
October 16, 1978

Built by General Dynamics Corp.'s Quincy, Mass., shipyards, Vanguard was commissioned Oct. 15, 1966, and became the last of three identical ships (Mercury, Redstone, Vanguard) to come off the Quincy ways specifically designed for, and dedicated to, manned space flight. However, the three sister ships frequently demonstrated their versatility by supporting automated scientific satellite missions.

Unlike the smaller manned spacecraft reentry coverage ships, USNS Watertown and USNS Huntsville, the larger ships were capable of supporting all aspects of a manned mission as well as unmanned scientific satellites. The reentry ships were for that purpose only.

The Vanguard's capabilities were far more extensive. It could function as well as any ground tracking station. This means that voice commands, biomedical data, spacecraft environment reports and command/control functions were transmitted and received through the ships direct from the Mission Control Center at Houston. The ships were in the tracking network to make certain there was communication with spacecraft when they could not be "seen" by land tracking stations.

Precise distances traveled and hours of mission support have not been calculated, but Space Tracking and Data Network (STDN) veterans estimate that fully half of the Vanguard's NASA lifetime was spent in a mission support status; the remainder being in port, yard repair or transit time.

Presently berthed in Oakland, Calif., Vanguard will begin its new career under the Navy's Strategic Systems Project Office.

-end-

NASA News

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Headquarters, Washington, D.C.
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For Release:
IMMEDIATE

RELEASE NO: 78-158

NASA, ESA SIGN AGREEMENTS FOR HANDLING OF SATELLITE DATA

NASA and the European Space Agency have signed three memoranda of understanding related to the use of data transmitted by the Landsat, Nimbus-G and Seasat satellites.

The memoranda, signed by NASA Administrator Dr. Robert A. Frosch and ESA Director General Roy Gibson in Paris Oct. 7, concern the acquisition by European ground stations, pre-processing and distribution of data from the Landsat series of satellites and several ESA-coordinated investigations involving data received in Europe from NASA's Nimbus-G and Seasat satellites.

The Landsat data will be made available to interested users by Earthnet, a European ground station network set up by ESA. Seasat data is to be used by the Seasat Users Research Group Europe (SURGE) under the auspices of the European Association of Remote Sensing Laboratories (EARSEL).

- more -

Mailed:
October 18, 1978

Nimbus-G data will be utilized by a further group of European investigators sponsored by the Commission of the European Communities (Common Market).

The Landsat 2 and 3 satellites are in polar orbits at about 805 kilometers (500 miles) altitude; Nimbus-G is scheduled for launch into a similar orbit Oct. 23. Seasat, launched into polar orbit June 26, ceased transmitting data Oct. 10. Scientists and engineers are working to determine the cause of its malfunction.

- end -

NASA News

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For Release:

IMMEDIATE

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RELEASE NO: 78-159

NASA ENGINEERS AND SCIENTISTS CONTINUE ATTEMPTS TO REVIVE SEASAT

NASA scientists and engineers are continuing their attempts to revive Seasat, the ocean monitoring satellite that went suddenly quiet prior to its orbital pass over the Santiago, Chile, tracking station just before midnight EDT Tuesday, Oct. 10.

Gene Giberson, Seasat project manager from NASA's Jet Propulsion Laboratory, Pasadena, Calif., said that engineers there and at NASA's Goddard Space Flight Center, Greenbelt, Md., are "assembling and analyzing tracking station data" from the spacecraft in an attempt to determine the possible cause of the interruption in the flow of Seasat data.

"We are not yet ready to give up in our attempts to re-establish contact with the spacecraft," Giberson said.

-more-

Mailed:
October 19, 1978

Once the data are assembled and analyzed, NASA engineers will work backward and try to reconstruct a "failure model" that will match the data received just prior and up to the instant the spacecraft ceased transmitting. If such a match can be made, the next step would be to determine, if possible, an alternate method of reestablishing contact with the spacecraft. These steps could take as long as two weeks.

Presently Seasat is not receiving full benefit from its solar panels because they are in full Sun only during 50 per cent of the spacecraft's orbits. In December the spacecraft will be in full Sun during 100 per cent of its orbits around the Earth and its batteries could possibly be charged enough to overcome a problem caused by insufficient electrical power.

-end-

NASA News

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For Release
IMMEDIATE

RELEASE NO: 78-160

NASA NAMES SEASAT FAILURE INVESTIGATOR

NASA's Deputy Administrator, Dr. Alan M. Lovelace, has announced the convening of a review board to attempt to determine the actual cause of the Seasat satellite failure last week as it orbited some 500 miles above the Atlantic Ocean.

Dr. Lovelace has named Dr. Bruce Lundin, who recently retired as Director of NASA's Lewis Research Center in Cleveland, Ohio, to head up the review board. The board's other members will be named shortly.

In 1973, Dr. Lundin was Chairman of the Skylab 1 Investigation Board which investigated the causes of that spacecraft's solar panels failure to deploy in orbit.

- end -

Mailed:
October 19, 1978

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For Release

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IMMEDIATE

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RELEASE NO: 78-161

NASA AWARDS 3 STUDY CONTRACTS FOR SOLAR ENERGY CONCENTRATOR

NASA's Jet Propulsion Laboratory, Pasadena, Calif., acting for the U.S. Department of Energy (DOE), has awarded three study contracts for development of a solar energy concentrator for generating electrical power.

The companies are: Acurex, Inc., Mountain View, Calif.; Boeing Engineering & Construction Co., Seattle, Wash.; and General Electric Space Division, Valley Forge, Pa.

-more-

Mailed:
October 20, 1978

The contracts, each valued at about $240,000, will be for the first part of a two-phase program aimed at development of a low-cost point-focusing solar concentrator. As many as six will be tested and evaluated at JPL's Solar Thermal Test Site at Edwards, Calif.

A point-focusing solar concentrator directs mirror-reflected sunlight to a point, at which is located a heat absorber and a heat-driven engine. The engine turns a generator to produce electricity. Utilizing this concept, solar energy can provide supplementary electrical power for small communities and rural areas.

The solar concentrator to be developed under the new contracts includes the optics (mirrors) and the mechanism that allows the concentrator to track the Sun. Heat absorbers and engine generators are being developed under separate contracts.

Prime objective of the three contract awards is determining of the best way to obtain the greatest thermal performance at the least cost per concentrator.

The study is managed by JPL for DOE's Small Power Systems Program. The work is being done for DOE under an interagency agreement with NASA.

-end-

NASA News

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For Release

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IMMEDIATE

RELEASE NO: 78-162

NOTE TO EDITORS:

SPACE SHUTTLE STATUS

With a target date of Sept. 28, 1979, for the first manned orbital flight of NASA's Space Shuttle, fabrication and testing of components continue at various locations throughout the U.S.

Measures have been taken to accelerate production and installation of the Thermal Protection System (TPS) tile for Orbiter 102. Staffing has been increased at both the Rockwell International facility at Palmdale, Calif., and at the Lockheed plant at Sunnyvale, Calif., where the tiles are made. New tile inspection equipment has been obtained to improve productivity of the tile.

-more-

Mailed:
October 24, 1978

Testing of the Space Shuttle Main Engine (SSME) continues at NASA's engine test facility near Bay St. Louis, Miss. Between Sept. 10 and Oct. 12, 13 test firings were conducted on two engines for a total of 3,794 seconds. Ten of those tests reached rated power level (RPL), accumulating 3,096 seconds.

Three of the tests were prematurely shut down, two for instrumentation problems and one (first test on engine 0006) when propellant priming of the engine oxidizer system occurred out of sequence and caused damage to a fuel turbopump turbine and the main injector of the engine.

Results of an extensive hardware inspection of engine 0005, after a series of 16 test firings in August and September, have been described as very satisfactory by project engineers at NASA's Marshall Space Flight Center, Huntsville, Ala.

Total engine testing through Oct. 11, shows 350 engine test firings for a total time of 26,530 seconds, including 8,969 seconds at RPL.

Full duration testing of the complete main propulsion system, a cluster of three engines, is scheduled for early 1979 when the first manned orbital flight configuration engines become available.

The third static test firing of a solid rocket booster (SRB) motor was conducted Oct. 19 at the Thiokol Chemical Corp.'s test site near Brigham City, Utah. Early data indicates a successful test firing. Gimbaling of the motor nozzle also appeared to be satisfactory from early test data.

Meanwhile, all elements of a Space Shuttle have been mated for the first time -- two SRBs, an external tank and an orbiter (101) for vertical vibration testing at the Marshall Center. The testing is to verify that the Space Shuttle structure will perform during various stages of the flight as predicted.

-end-

NASA News

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For Release:
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Ralph B. Jackson
Dryden Flight Research Center, Edwards, Calif.
(Phone: 805/258-8381)

RELEASE NO: 78-163

DEPUTY DIRECTOR NAMED AT NASA'S DRYDEN FLIGHT RESEARCH CENTER

John W. Boyd has been named Deputy Director of NASA's Dryden Flight Research Center, Edwards, Calif. The assignment, effective Jan. 1, 1979, was announced Oct. 20 by NASA Deputy Administrator, Dr. Alan M. Lovelace.

Dryden Center is NASA's major field installation for flight testing high speed aircraft and other experimental vehicles. Approach and landing tests of the Space Shuttle were carried out here last year and recovery of the spacecraft from its initial orbital flights will be made here next year.

-more-

Mailed:
October 24, 1978

Boyd replaces Isaac T. Gillam who was named Director of Dryden Center in June this year.

He is presently Deputy Director of Aeronautics and Flight Systems at NASA's Ames Research Center, Mountain View, Calif. He first joined Ames in 1947 and served in a variety of positions until being appointed to his present position in 1970.

Born in Danville, Va., Aug. 19, 1925, Boyd received his B.S. degree in aeronautical engineering from Virginia Polytechnical Institute in 1947. He is a 1955 graduate of Stanford School of Business under a Stanford Sloan Fellowship.

Author of many technical reports, Boyd has received several honors for his work, including the NASA Exceptional Service Award. He and his wife and five children presently live in Saratoga, Calif.

-end-

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release:
IMMEDIATE

RELEASE NO: 78-164

NEW TIROS OPERATES AS PLANNED

The TIROS-N third generation weather satellite launched from the Western Test Range near Lompoc, Calif., Oct. 13, is returning excellent quality data and pictures from a near-perfect circular polar orbit 870 km (543 miles) by 860 km (537 miles).

TIROS-N's Advanced Very High Resolution Radiometer (AVHRR), the Automatic Picture Transmission (APT) system and the High Resolution Picture Transmission (HRPT) system designed to provide local area coverage to hundreds of weather forecasters around the world are all working.

After checkout by NASA, which is expected to be complete in three weeks, the new weather satellite will be turned over to the National Oceanic and Atmospheric Administration (NOAA) for operational use.

- end -

Mailed:
October 24, 1978

LH-14

NASA News

National Aeronautics and
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Washington, D.C. 20546
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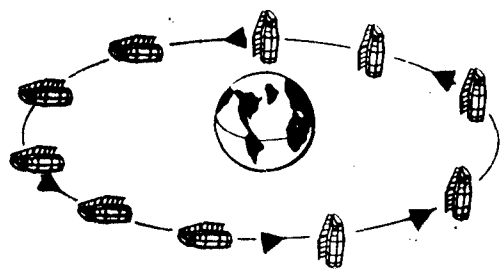
For Release THURSDAY,
November 9, 1978

Press Kit

Project HEAO 2

RELEASE NO: 78-165



Contents

Mailed:
November 3, 1978

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 755-8370

For Release:

Nicholas Panagakos
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(Phone: 202/755-3680)

THURSDAY,
November 9, 1978

Don Worrell
Marshall Space Flight Center, Huntsville, Ala.
(Phone: 205/453-0035)

RELEASE NO: 78-165

SECOND HIGH ENERGY ASTRONOMY OBSERVATORY LAUNCH SET

NASA is preparing to launch its second High Energy Astronomy Observatory (HEAO), continuing a three-mission program to study some of the most intriguing mysteries of the universe -- pulsars, quasars, exploding galaxies and black holes in space.

HEAO 2 will be launched into Earth orbit atop an Atlas Centaur rocket from Kennedy Space Center, Fla., about Nov. 13.

-more-

Carrying a focusing X-ray telescope and a variety of sensitive instruments, HEAO 2 will maneuver and point for long periods of time at selected X-ray sources already identified by its predecessor, HEAO 1.

HEAO 1 was launched last year to conduct a general X-ray sky survey, and HEAO 3 will be launched in 1979 to collect celestial gamma ray and cosmic ray data.

These high-energy rays cannot be studied through Earth-based telescopes because of the obscuring effects of our atmosphere. The rays were observed initially by instruments on sounding rockets and balloons, and by small satellites which did not have the instrumentation capabilities required for high data resolution and sensitivity. These capabilities are now available in the HEAO satellite.

The "pictures" returned by HEAO 2 will be the first spacecraft-generated X-ray images of wide objects other than the Sun. (The Apollo Telescope Mount, which was part of Skylab, produced images of the Sun in the X-ray region.) HEAO 2's images, acquired by the X-ray telescope, will be converted to telemetry, then received and taped by ground stations. Eventually this telemetry will be reconstructed as photographs showing size, structure and detail of the objects viewed by HEAO.

-more-

Information returned by HEAO may provide clues to the nature of some of the "newest" and most mysterious celestial objects in the universe. This knowledge, in turn, could lead to a better understanding of the invisible high-energy universe and to new theories about energy production and high-density nuclear matter.

The first observatory is still operational, surveying and mapping X-ray sources throughout the celestial sphere and also measuring the low-energy gamma ray flux. The spacecraft can survey the entire sky in six months. Although HEAO 1 was designed for only a six-month lifetime, the quality of the data return was so excellent that an extension was authorized. The spacecraft is expected to remain active until it reenters Earth's atmosphere or depletes the onboard control gas supply, probably in early or mid-1979. Besides mapping the X-ray sky, the highly successful satellite has performed more than 300 pointing operations.

• HEAO 1 scientific results indicate that the map of X-ray sources will contain up to 1,500 sources when all data have been analyzed. This number would increase the previously known number of X-ray sources by a factor of four.

• A map of the diffuse celestial X-ray background has been completed. There is strong evidence that a major contributor to this background is a hot universal gas which may constitute a significant fraction of the mass of the universe. Another large component of universal matter has been detected by HEAO in the form of gas enveloping clusters of galaxies.

• Precise positions (within 10 arc seconds or better) have been developed for about 140 X-ray sources. The precise positions have enabled ground-based astronomers to locate many of these as faint visible objects. (See detailed HEAO 1 science results on page 9.)

HEAO 1 and HEAO 3 are designated as scanning (or mapping) missions. They rotate slowly end-over-end, with one revolution about every 30 minutes. Each uses a gas thrust reaction control system to maintain proper sky-scanning orientation so that the solar arrays face the Sun at all times to provide electrical power for the satellite.

HEAO 2 is different. It must point to specific stars or points in the sky, so reaction wheels that control torque are installed to provide a precise and highly accurate pointing capability of one arc minute or better for the longer planned mission. HEAO 2 is termed a celestial pointing mission.

HEAO 2 has a designed mission lifetime of one year for pointing at selected X-ray sources. HEAO 3's mission will be six months long.

All three observatories are designed to be placed in low circular orbits, about 455 to 540 kilometers (280 to 335 miles) above Earth. The altitude is far enough above the atmosphere to detect radiation which generally cannot reach the ground.

X-rays and gamma rays are composed of photons, which are particles having energy but no mass, as in light rays. Cosmic rays are composed of particles such as electrons, protons and atomic nuclei which have both mass and energy. An X-ray has thousands of times the energy of ordinary light, and gamma rays have millions of times the energy of visible light.

The high-energy X-rays and gamma rays which the HEAOs study travel through space at the speed of light. They are forms of electromagnetic radiation. Other forms include ultraviolet and infrared radiation.

For many years researchers have studied these forms of radiation and their energy mechanisms and have transformed them into many practical uses, including electrical applications, holography, radio and television, radar and infrared photography.

In high-energy astronomy, interest is in the extreme short-length waves known as X-rays and gamma rays. These rays are produced on Earth by natural radioactive minerals and manmade processes. X-rays and gamma rays on Earth are produced from well-understood physical processes and are used routinely in physics, chemistry, engineering, medical and other scientific fields.

Much is yet to be learned, however, about the way in which X-rays and gamma rays are produced in deep space -- in some cases, with incredible intensity.

It is expected that the radiation data collected by the HEAO observatories, after being reduced and analyzed, will lead to a better understanding of how the extremely high energies are generated in space, how basic elements are formed, how the universe evolved and the extreme physical processes evident within the universe.

Several hypotheses are being pursued in astrophysics and cosmology that need additional experimental evidence which may be obtained by HEAO. These hypotheses are related to radio galaxies, neutron stars, pulsars, quasars, star explosions and supernovae, many of which radiate copiously in the X-ray and gamma ray part of the spectrum. (See glossary, page 17.)

HEAO is managed for NASA's Office of Space Science by the Marshall Space Flight Center, Huntsville, Ala. The Program Manager is Richard E. Halpern and the Program Scientist is Dr. Albert G. Opp, both at NASA Headquarters in Washington, D.C. At the Marshall Center, Dr. Fred A. Speer is the Project Manager. Spacecraft prime contractor is TRW of Redondo Beach, Calif. The X-ray Telescope was designed by Smithsonian Astrophysical Observatory (SAO) and developed by American Science and Engineering (AS&E), both of Cambridge, Mass.

Kennedy Space Center manages the launch operations, including prelaunch checkout, launch and flight through observatory separation in orbit. NASA's Lewis Research Center, Cleveland, Ohio, manages launch vehicle procurement and related activities for the HEAO program.

Control of the in-orbit HEAO observatories is under the direction of the Marshall Center in conjunction with TRW flight control engineers operating from facilities at NASA's Goddard Space Flight Center, Greenbelt, Md.

Cost of the three-mission HEAO program is about $248 million. The cost of HEAO 2 will be approximately $87 million.

(END OF GENERAL RELEASE. BACKGROUND INFORMATION FOLLOWS.)

HEAO 1 SCIENCE RESULTS

- Over 130 sources of X-ray radiation have been identified from data analyzed thus far for one ninth of the sky. Many of these were previously undetected. (Many sources have been located with high precision, allowing astronomers to search for visible counterparts.)

- HEAO 1 has returned the highest quality spectal and temporal data yet obtained on neutron stars, and a black hole possibility has been identified near Constellation Scorpius, bringing the total to four. (Others: Cygnus X-1, Circinus X-1, and Hercules X-1.) Also, significant new measurements have been made on neutron stars regarding magnetic fields and dynamics.

- Previously undetected hot thermal plasma has been discovered. The plasma, distributed throughout space, may constitute the bulk of the mass of the universe. This may help answer the question of whether the universe will continue to expand forever or eventually start contracting.

- Extreme variability has been discovered in the X-ray energy band of objects such as quasars (which produce over a billion times the luminosity of the Sun, but may be no larger than the solar system).

- X-ray data have been obtained from the vicinity of two quasars about eight billion light years distant--more than half way to the outer edge of the universe.

- Pronounced soft X-ray emission has been detected for the first time from cataclysmic variable stars (novas, which exhibit extreme flaring, but not supernovas).

- Coronas of normal stars like our Sun have been detected in the X-ray band.

- Strong X-ray emission has been detected, apparently from very hot stellar winds from certain types of stars.

- A massive quantity of gas enveloping two clusters of galaxies has been detected, indicating that sufficient mass may exist in all such systems to convince scientists that the universe is "closed."

HEAO SPACECRAFT AND OBSERVATORY

The basic subsystems design of the HEAO spacecraft is common for all three missions. The shape, arrangement and objectives of the experiments on the three spacecraft are different for each mission.

The observatories (i.e., spacecraft plus experiments) each weigh about 3,150 kilograms (7,000 pounds), including 1,350 kg (3,000 lb.) of experiments. Overall observatory length is 5.8 meters (19 feet).

The HEAO spacecraft subsystems take advantage of existing hardware designs developed in other spacecraft programs. About 80 per cent of HEAO hardware designs are "off-the-shelf."

The HEAO 2 experiment module structure is octagonal, and combines simplicity with maximum rigidity and focal length in support of the X-ray telescope.

HEAO 2 mission requirements are met through simple modifications to the HEAO 1 design. For example, the HEAO 2 pointing and stability requirements are met by placing a reaction wheel system in an empty area of the equipment module. The extra electrical power required to drive the wheels is produced by increasing the size of the solar array.

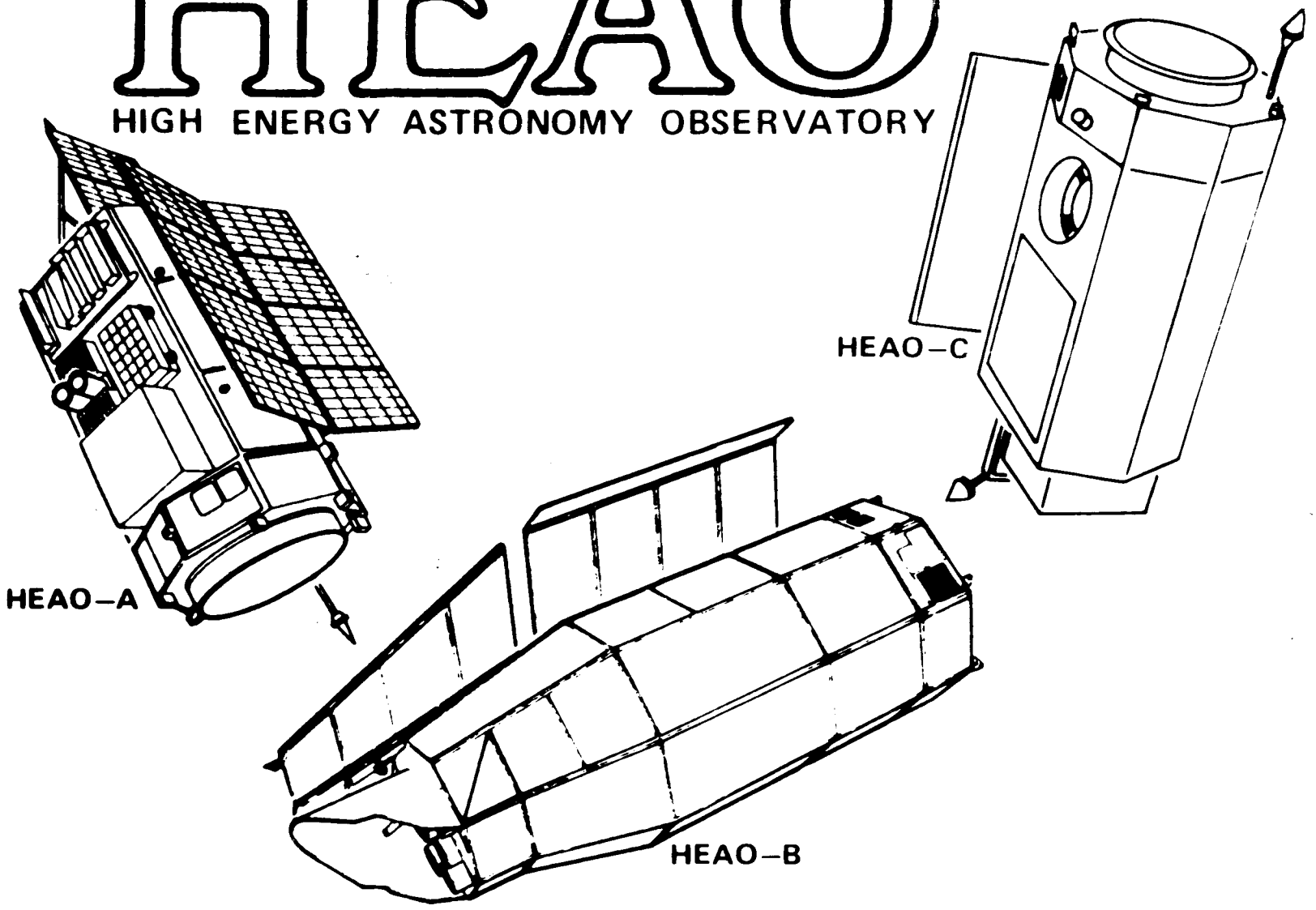
LAUNCH VEHICLE

Contractor for the Atlas booster stage (SLV-3D) is General Dynamics Convair Aerospace Division. The stage-and-one-half Atlas is powered by three engines -- two Rocketdyne YLR-89-NA-7 engines providing 1,646,000 newtons (370,000 lb.) of thrust and one Rocketdyne YLR-105-NA-7 engine with 267,000 N (60,000 lb.) thrust. All three engines operate on liquid oxygen and RP-1 propellants.

General Dynamics is also contractor for the Centaur upper state (D-1A), which is powered by two Pratt and Whitney RL10A-3-3 engines with a total thrust of 133,400 N (30,000 lb). These engines operate on liquid oxygen and liquid hydrogen.

HEAO

HIGH ENERGY ASTRONOMY OBSERVATORY



Physical characteristics of the Atlas SLV-3D stage are:

Length 21 m (70 ft.)

Diameter 3 m (10 ft.)

Dry weight 7,210 kg (15,900 lb.)

Launch weight 130,450 kg (287,600 lb.)

Physical characteristscs of the Centaur D-1A upper stage are:

Length 9 m (30 ft.)

Diameter 3 m (10 ft.)

Dry weight 1,770 kg (3,900 lb.) excluding nose fairing

Launch weight 17,690 kg (39,000 lb.)

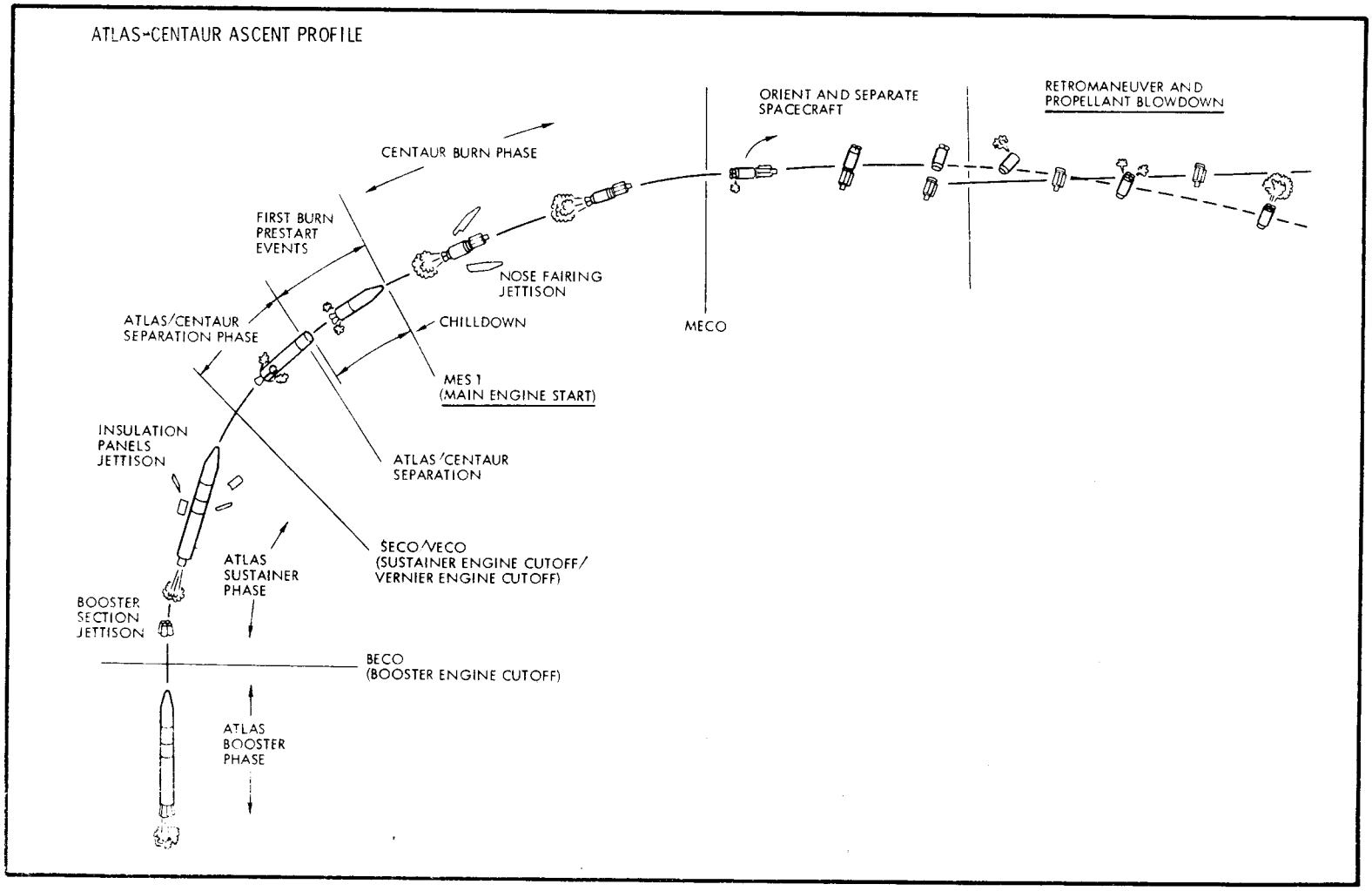
Total height of the HEAO Atlas-Centaur space vehicle ready for launch, is 39.9 m (131 ft.) with a launch weight of about 149,600 kg (329,900 lb.) for HEAO-2

HEAO LAUNCH OPERATIONS

NASA's John F. Kennedy Space Center, Fla., and its Expendable Vehicles Directorate play key roles in the preparation and launch of Atlas-Centaur 52 which will carry HEAO-2 into orbit.

The Atlas booster was erected on Pad B at Launch Complex 36, Cape Canaveral Air Force Station, on Sept. 6, and the Centaur upper stage was mated with it on Dept. 8.

The HEAO-2 observatory arrived at KSC aboard a C-5A aircraft during the week of Sept. 11 and was moved into Spacecraft Assembly and Encapsulation Facility 2 for prelaunch processing.

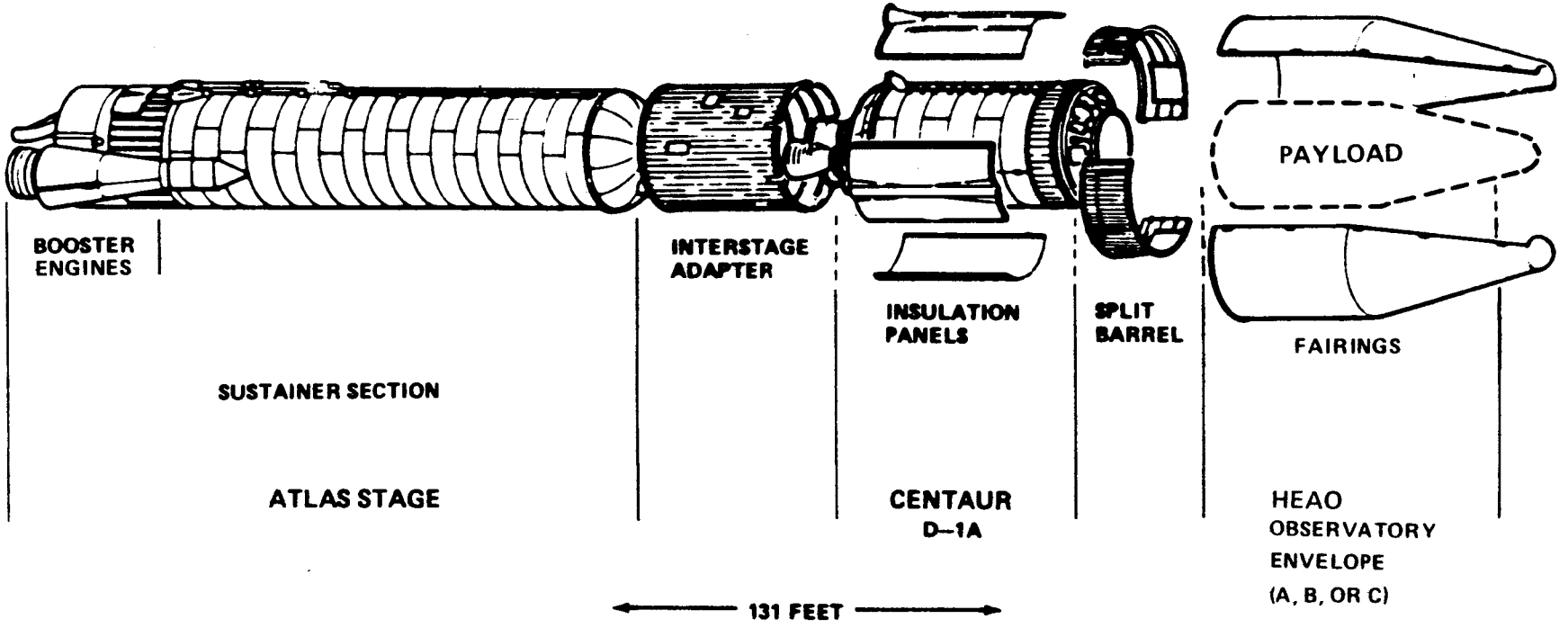

ATLAS-CENTAUR ASCENT PROFILE
ORIENT AND SEPARATE SPACECRAFT
RETROMANEUVER AND PROPELLANT BLOWDOWN
CENTAUR BURN PHASE
FIRST BURN PRESTART EVENTS
NOSE FAIRING JETTISON
ATLAS/CENTAUR SEPARATION PHASE
CHILLDOWN
MECO
MES 1 (MAIN ENGINE START)
INSULATION PANELS JETTISON
ATLAS/CENTAUR SEPARATION
SECO/VECO (SUSTAINER ENGINE CUTOFF/ VERNIER ENGINE CUTOFF)
ATLAS SUSTAINER PHASE
BOOSTER SECTION JETTISON
BECO (BOOSTER ENGINE CUTOFF)
ATLAS BOOSTER PHASE

TYPICAL ATLAS-CENTAUR SEQUENCE OF EVENTS

Event	Basis	Approx. Time From Liftoff (Sec.)
Liftoff	2-in. Motion	0
Roll Program	Liftoff + 2 sec.	2-15
BECO	5.3 g	140
Booster Package Jettison	BECO + 3.1 sec.	145
Jettison Insulation Panels	BECO + 45 sec.	187
SECO	Prop. Depletion	247
Separation	SECO + 1.9 sec.	249
MES 1	SECO + 11.5 sec.	259
Jettison Nose Fairing	MES 1 + 12 sec.	270
MECO 1	Final Orbit (Guid.)	700
Separation	MECO 1 + 660 sec.	1360

ATLAS/CENTAUR D-1A

HEAO SPACE VEHICLE FOR A, B, & C OBSERVATORIES



HEAO MISSION OPERATIONS

Control of the in-orbit HEAO observatories is directed by Marshall flight control engineers at the Goddard center. Flight control operations are performed by TRW under the direction of the Marshall flight director and supported by experimenters associated with each HEAO mission.

The Marshall center directs the mission planning and establishes support requirements to be met by the world-wide Spaceflight Tracking and Data Network (STDN), the Operations Control Center and Data Processing Center.

Goddard provides and operates these network and mission operations support facilities required by Marshall to control and operate the observatories.

These existing NASA facilities are prepared and configured as necessary to support the HEAO missions.

The large amounts of data taken by each of the HEAO observatories are reduced and analyzed by the principal investigators, co-investigators and other scientists from the United States representing various industries, universities and government agencies. They make known their findings in various reports, papers and publications.

HEAO 2 MISSION DESCRIPTION

HEAO 2 will examine specific X-ray sources from an orbit inclined 23.5 degrees to the equator and at a height of 535 km (330 miles.)

The observatory will be placed in orbit by an Atlas-Centaur D-1A launch vehicle. The ascent profile, the same as that for HEAO 1, is shown in the diagram on page 12.

After insertion into orbit, the HEAO goes through three principal modes of operation:

1. Activation. This mode includes solar array deployment, removal of separation transients, Sun acquisition, and activation of thermal control heaters and standby heaters, if necessary. Then subsystems are activated, calibrated and checked out. During this procedure, the +Z axis is held within a seven degree half-cone angle of the Sun line.

2. Experiment checkout. Experiments are activated and checked out after observatory subsystems are operating properly. The initial data from each experiment will be obtained by an on-off cycle so that experiment operation can be evaluated before turn-on for routine operation.

3. Celestial point. The routine point mode, initiated by ground command, will be continuous for 12 months. The alignment of the +Z axis toward the Sun will be maintained within 15 degrees half-cone angle of a chosen reference. Up to two targets per orbit are available by design.

The observatory will be controlled in orbit by the HEAO Operations Control Center (HEAO-OCC) at Goddard. Observatory data stored in the on-board tape recorder will be transmitted to tracking sites at a rate of 128 kbps. Data from six orbits per day will be relayed to the HEAO-OCC at a reduced rate and will be used for evaluation by principal investigators.

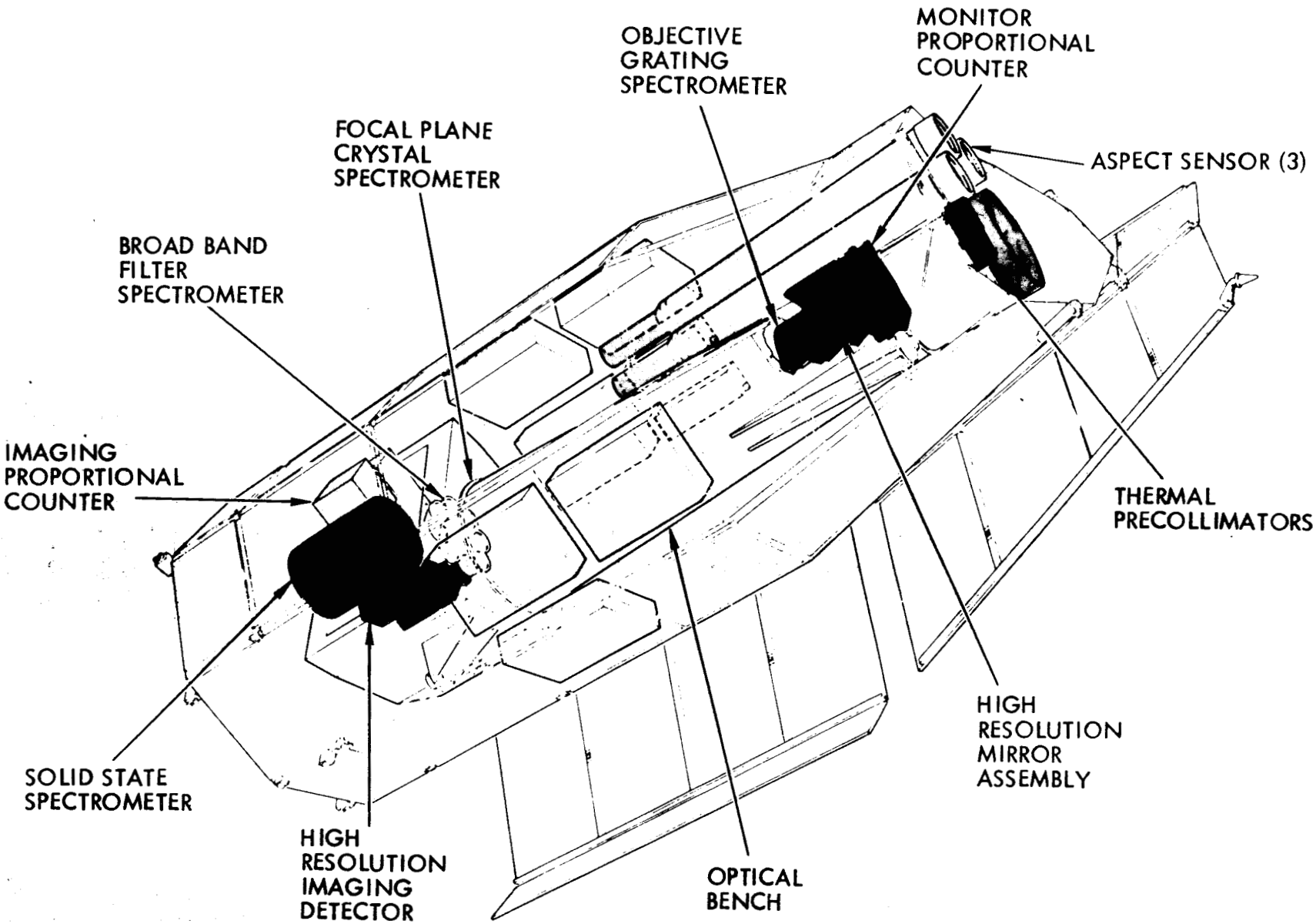
Tracking stations permit relay of data to the HEAO-OCC at 9.6 to 56 kbps.

HEAO 2 EXPERIMENTS

A consortium of experimenters has been organized involving scientists from five organizations, including the Smithsonian Astrophysical Observatory (SAO), Massachusetts Institute of Technology (MIT), American Science and Engineering (AS&E), Goddard Space Flight Center (GSFC) and Columbia Astrophysics Laboratory (CAL). The principal investigator and scientific director of the consortium is Dr. Riccardo Giacconi of SAO.

The grazing-incidence X-ray telescope on HEAO 2 will produce images of X-ray sources which are then analyzed by interchangeable instruments at the focal plane of the telescope. In addition to the instruments at the focal plane, there is one complementary instrument which directly views the areas out in space along the same direction as the telescope.

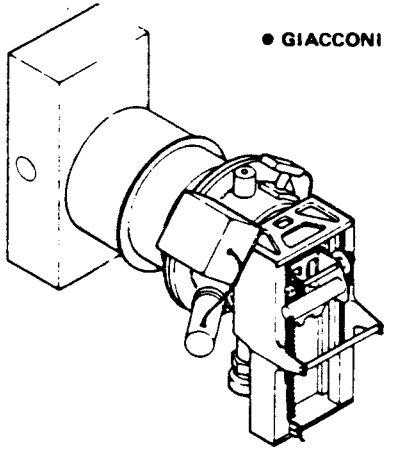
HEAO-B EXPERIMENTS



HEAO-B EXPERIMENTS

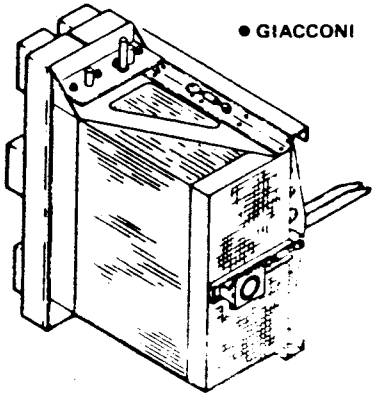
B-2 HIGH RE OLUTION IMAGER

• GIACCONI



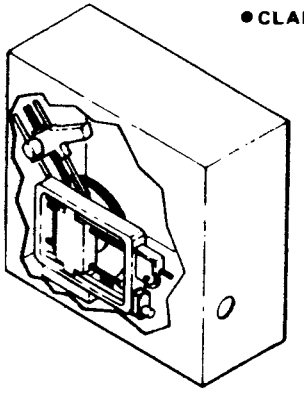
B-1 MONITOR
PROPORTIONAL COUNTER

• GIACCONI



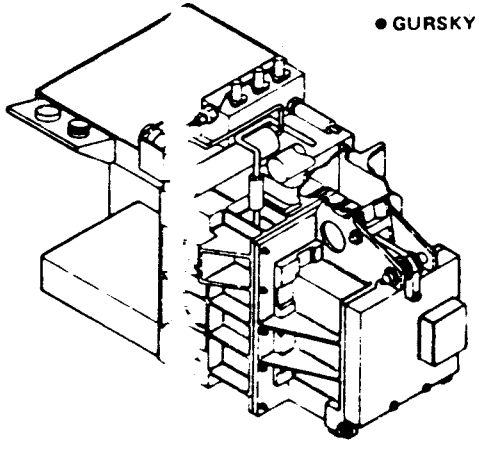
B-3 FOCAL PLANE
CRYSTAL SPECTROMETER

• CLARK



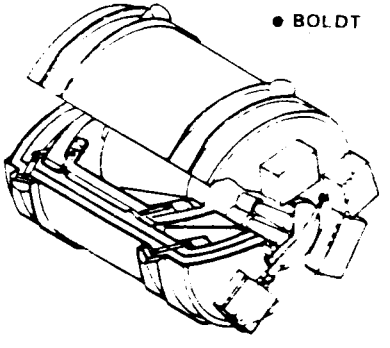
B-4 IMAGING PROPORTIONAL
COUNTER

• GURSKY



B-5 SOLID STATE
SPECTROMETER

• BOLDT



The science objectives of the HEAO 2 telescope experiment are:

- Determine structural details of extended wide X-ray sources and identify with optical objectives by studying X-ray images.

- Perform spectroscopy measurements to determine X-ray emission mechanism and spectral features.

- Analyze temporal behavior of X-ray sources on a scale of one microsecond to one year.

HEAO 2 telescope instruments are:

B-1: Monitor Proportional Counter. Principal Investigator is Dr. Giacconi. Hardware was developed by AS&E under NASA contracts.

The Monitor Proportional Counter is mounted near one end of the observatory and operates independently of the telescope. It observes the same region of the sky as the telescope but over a much wider energy range (0.2 to 20 KeV). It provides a means of correlating observations made by all the focal plane instruments.

B-2: High Resolution Imager Instrument. Principal Investigator is Dr. Giacconi. Hardware was developed by AS&E under NASA contracts.

The High Resolution Imager Instrument (like the Imaging Proportional Counter described below under B-4) is designed to take advantage of the imaging capability of the X-ray telescope. The High Resolution Imager uses advanced solid state techniques to record the images with a resolution of 1 - 2 arc seconds--the limit of the resoltuion capability of the telescope itself.

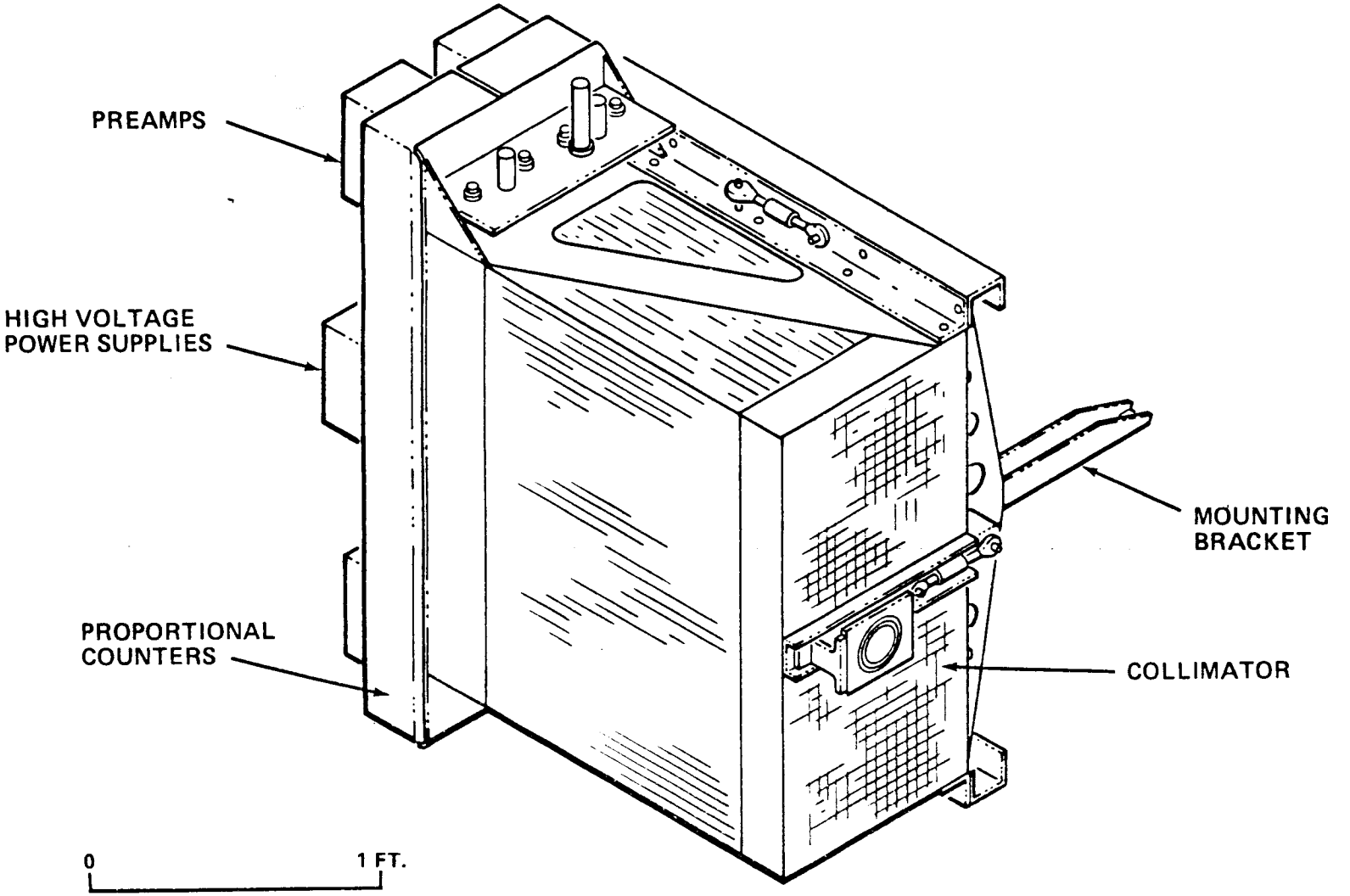
B-3: Focal Plane Crystal Spectrometer. Principal Scientist is Dr. George Clark of MIT. Hardware was developed by MIT under NASA contract.

The Focal Plane Crystal Spectrometer makes use of the X-ray deffraction properties of certain crystals to study in detail the X-ray spectra produced by celestial targets. The detector for the diffracted rays is a small proportional counter. This instrument can detect individual X-ray emission lines to help unravel questions about the chemical composition and other properties of the X-ray targets.

HEAO B-1 EXPERIMENT

MONITOR PROPORTIONAL COUNTER

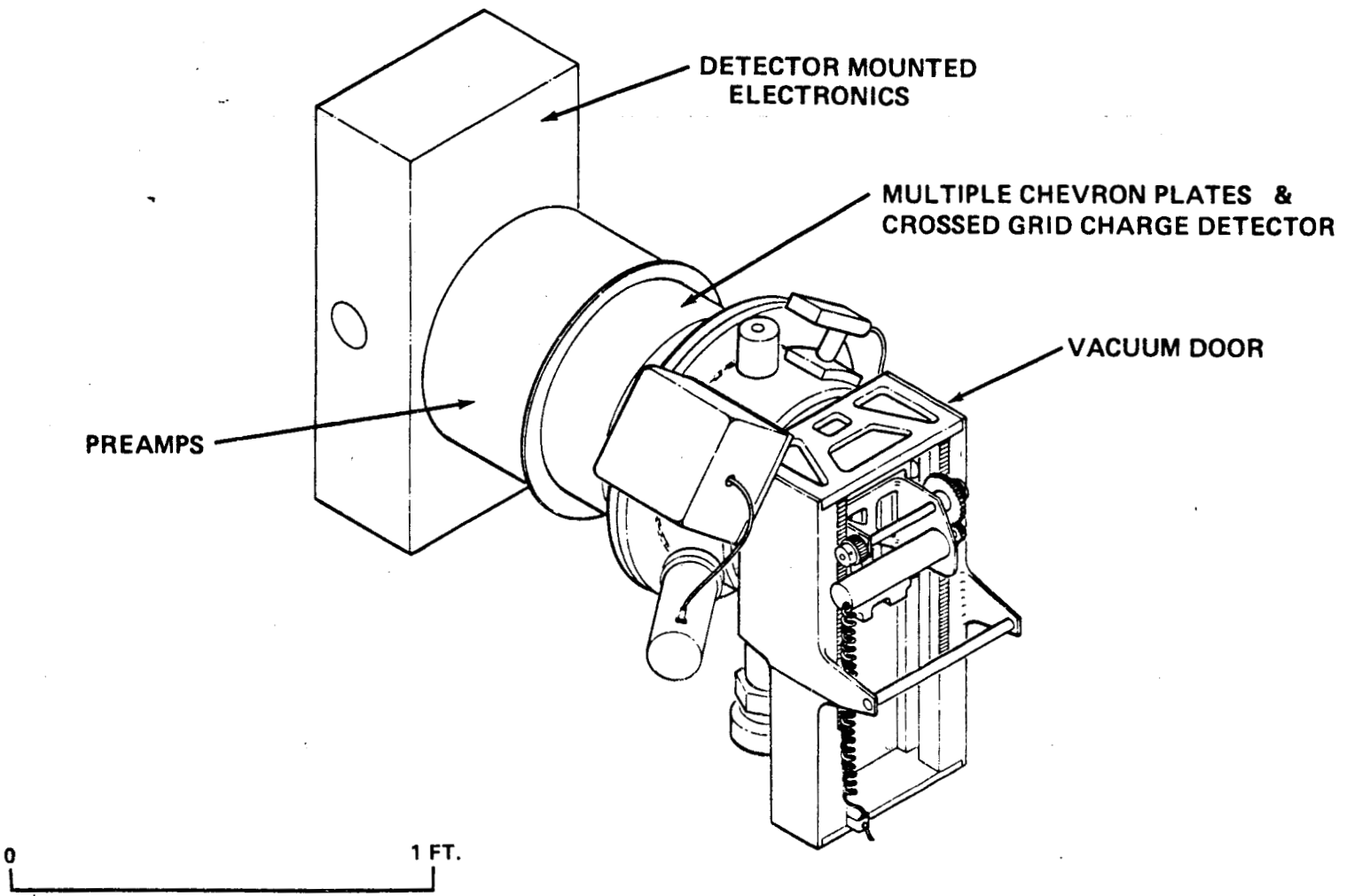
GIACCONI



HEAO B-2 EXPERIMENT

HIGH RESOLUTION IMAGER

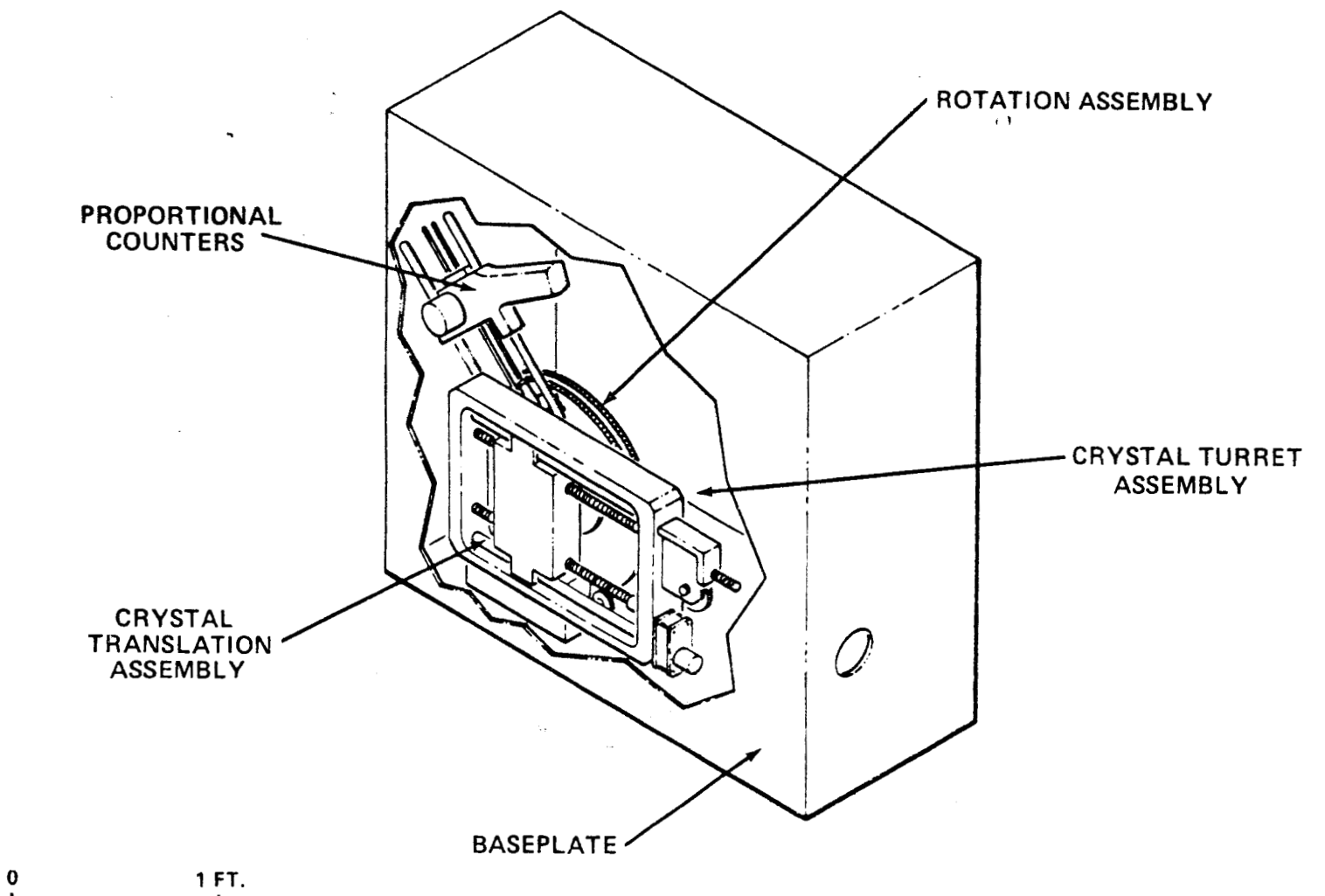
GIACCONI



HEAO B-3 EXPERIMENT

FOCAL PLANE CRYSTAL SPECTROMETER

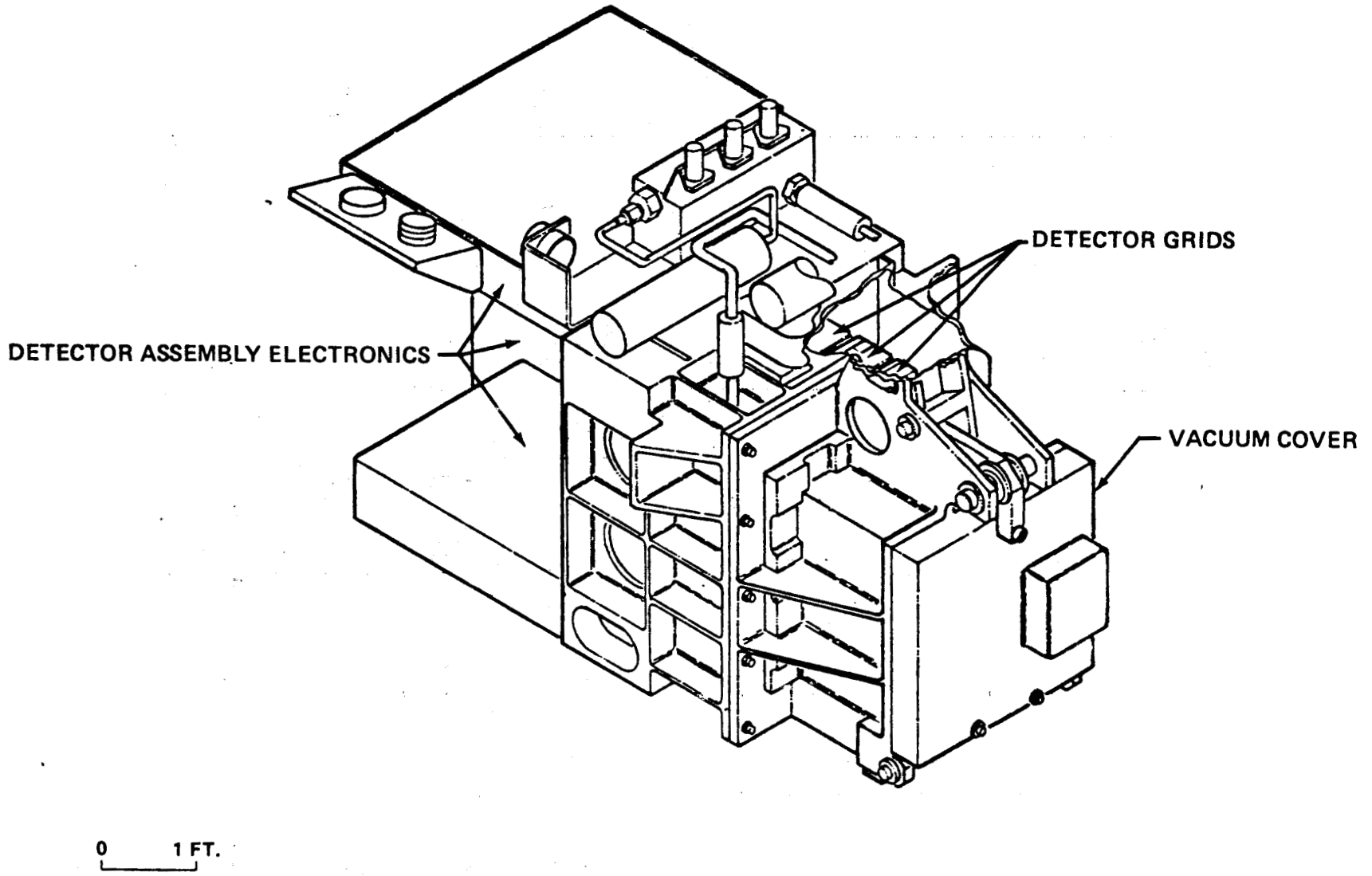
CLARK



HEAO B-4 EXPERIMENT

IMAGING PROPORTIONAL COUNTER

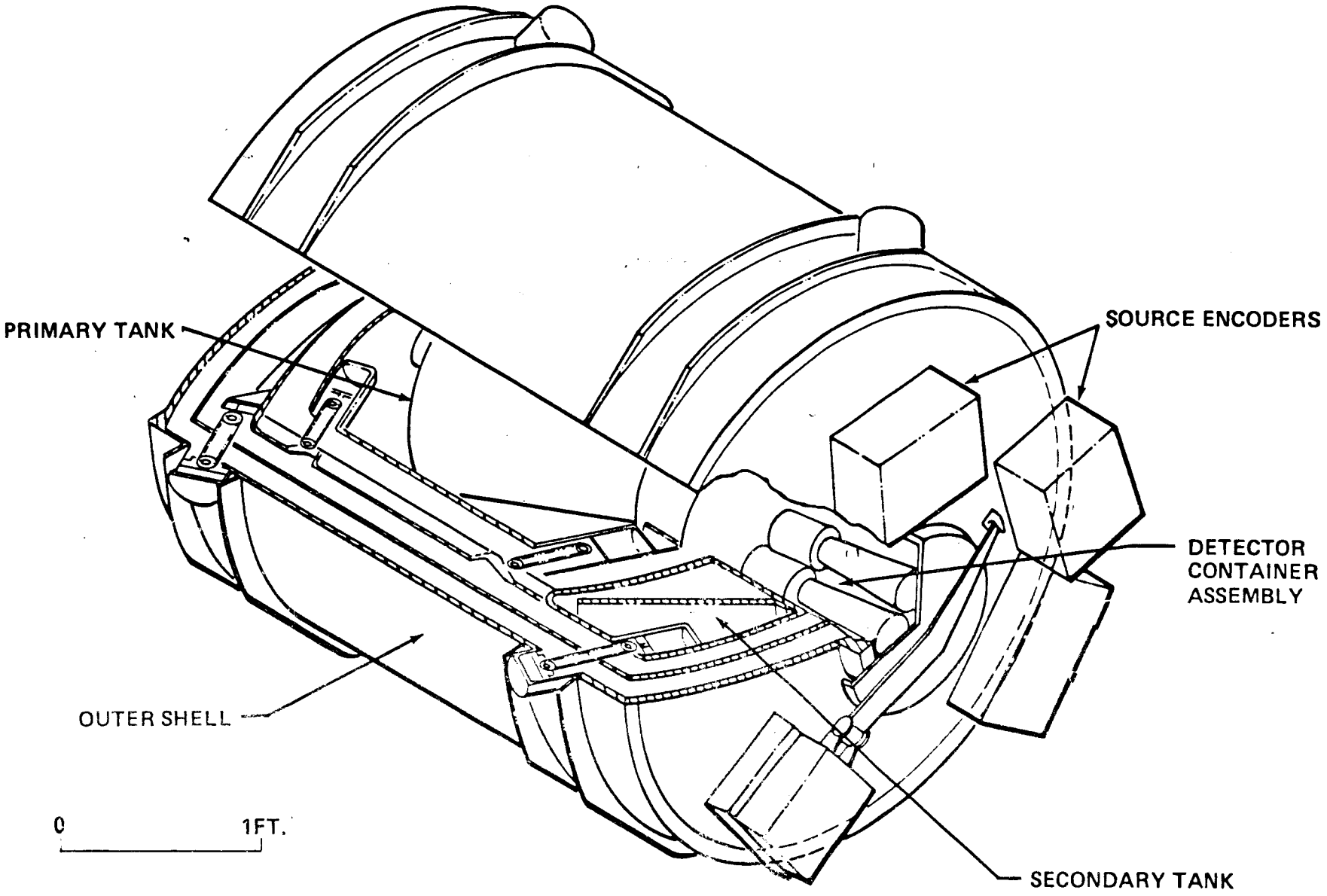
GURSKY



HEAO B-5 EXPERIMENT

SOLID STATE SPECTROMETER

BOLDT



To cover the full range of the telescope, six different crystals (mounted on a turret) are used.

B-4: Imaging Proportional Counter. Principal Scientist is Dr. Herbert Gursky of SAO. Hardware was developed by AS&E under NASA contract.

The Imaging Proportional Counter uses the same basic techniques as most of the X-ray detectors on HEAO 1, but the counter is electronically subdivided into very small regions so that each registers a small part of the X-ray image. The result is an image with a resolution of about one arc minute. What the Imaging Proportional Counter lacks in imaging resolution, it makes up in greater field of view than the High Resolution Imager.

B-5: Solid State Spectrometer. Principal Scientist is Dr. Elihu Boldt of GSFC. Hardware was developed by GSFC under an inter-center agreement.

The Solid State Spectrometer must be cryogenically cooled with solid methane and ammonia for its silicon-germanium crystal to function properly. Its advantage is that it can observe the entire spectrum at once, measuring the energy (and therefore wave-length) of each photon which strikes the crystal, whereas the Focal Plane Crystal Spectrometer can only examine a small band of energies at any one setting of the crystal turret. The two spectrometers complement each other in sensitivity and energy resolution.

Principal Scientist Dr. Robert Novick of CAL, is providing scientific support and performing data analysis as a member of the consortium group under NASA contract.

AS&E physically and functionally integrated the various instruments into a telescope experiment. The X-ray telescope was calibrated in the new X-ray Test Calibration Facility at the Marshall center. The assembled telescope was delivered from Marshall to TRW for integration with the spacecraft module.

GLOSSARY

Pulsars and Neutron Stars

Discovered in 1967, pulsars are stars which emit radio signals in extremely precise pulses. The bulk of available evidence suggests that pulsars may be fast-spinning neutron stars. These are compact bodies of densely packed neutrons (atomic particles having no electric charge), believed to form when a large star burns up much of its fuel and collapses. Containing the mass of a star in a sphere 16 km (10 mi.) in diameter, they are so closely packed that a spoonful of material from the center would weigh a billion tons.

Black Holes

These are believed to be the final stages in the collapse of a dying star. The star's material is so densely packed -- even more so than a neutron star -- and its gravitational force so great that even light waves are unable to escape. Black holes have been hypothesized but conclusive observations have not yet been possible.

Quasars

Astronomers are still baffled by the nature of quasars, but many believe that among observable objects they are the most remote in the universe. They look like stars when viewed through an optical telescope but emit more energy than the most powerful galaxies known. According to calculations, if they are as distant as many astronomers think they are, the total energy emitted by a quasar in one second would supply all of Earth's electrical energy needs for a billion years.

Radio Galaxies

Located on the fringes of visibility, radio galaxies emit radio waves millions of times more powerful than the emissions of a normal spiral galaxy. No one knows what these peculiar galaxies are. Several of them broadcast with such power that a sizable fraction of the nuclear energy locked up in their matter must be going completely into the production of radio waves.

Supernovae

Supernovae are large stars at their lives' ends whose final collapses are cataclysmic events that generate violent explosions, blowing the surface layers of the stars out into space. There, the materials of the exploded stars mix with other material of the universe (primarily hydrogen). Later in the history of the galaxy, other stars are formed out of this mixture. The Sun is one of these stars; it contains debris of countless others that exploded before the Sun was born.

There is strong evidence that supernovae (exploding stars) and pulsars are X-ray sources at some time in their history and that X-rays have been observed from radio galaxies and quasars.

THE HEAO 2 TEAM

NASA Headquarters

Dr. Noel W. Hinners	Associate Administrator for Space Science
Andrew J. Stofan	Deputy Associate Administrator for Space Science
Dr. Adrienne Timothy	Assistant Associate Administrator for Space Science
T. Bland Norris	Director, Astrophysics Programs
Richard E. Halpern	Manager, High Energy Astrophysics Payloads
John F. Yardley	Associate Administrator for Space Transportation Systems
Joseph B. Mahon	Director, Expendable Launch Vehicles
F. R. Schmidt	Manager, Atlas Centaur Launch Vehicle
Dr. William Schneider	Associate Administrator for Space Tracking and Data Systems

Marshall Space Flight Center

Dr. William R. Lucas	Director
Dr. Fred A. Speer	Manager, HEAO Project
Fred S. Wojtalik	Chief Engineer, HEAO Project
Charles H. Meyers	Manager, Spacecraft Office
Alex Madyda	HEAO 2 Mission Manager

-more-

Goddard Space Flight Center

Dr. Robert S. Cooper	Director
Dr. Steve Holt	Project Scientist, HEAO 2
Dr. Elihu A. Boldt	Principal Scientist, Solid State Spectrometer Experiment (B-4)
Richard S. Costa	Mission Operations Systems Manager
Tecwyn Roberts	Director of Networks, Tracking and Data Acquisition
Albert G. Ferris	Director, Mission and Data Operations

Kennedy Space Center

Lee R. Scherer	Director
Gerald D. Griffin	Deputy Director
Dr. Walter J. Kapryan	Director, Launch Operations
George F. Page	Launch Director, Expendable Vehicles
John Gossett	Chief, Centaur Operation Division
Laurence F.Kruse	Spacecraft Coordinator

Lewis Research Center

Dr. John McCarthy	Director
Larry Ross	Director, Launch Vehicles
Edwin T. Muckley	HEAO Project Engineer

Smithsonian Astrophysical Observatory

Dr. Herbert Gursky	Principal Scientist, Imaging Proportional Counter (B-4)
Dr. Riccardo Giacconi	Principal Investigator, Monitor Proportional Counter (B-1) and High Resolution Imager (B-2)

Massachusetts Institute of Technology

Dr. George Clark	Principal Scientist, Focal Plane Crystal Spectrometer (B-3)

Columbia University

Dr. Robert Novick	Consortium member

CONTRACTORS

TRW Redondo Beach, Calif.	Spacecraft design and manufacture, observatory integration
American Science and Engineering Cambridge, Mass.	Design and manufacture, X-ray telescope system
General Dynamics Convair San Diego, Calif.	Launch vehicle manufacture

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 755-8370

For Release:

UPON RECEIPT

Ken Atchison
Headquarters, Washington, D.C.
(Phone: 202/755-3147)

Marilyn Edwards
Lewis Research Center, Cleveland, Ohio
(Phone: 216/433-4000 Ext. 415)

RELEASE NO: 78-166

WIND TURBINE CONFERENCE SET

The marketing potential and technology status of large wind turbine electric generators will be reviewed at a conference for U.S. industry, Jan. 31, 1979, at NASA's Lewis Research Center, Cleveland.

NASA is supporting the Department of Energy (DOE) in developing, with the aid of U.S. industries, large wind turbine electric generators as a source of supplemental power for utility networks. The Lewis center is conducting both a technology development program and an experimental program with the utility industry.

-more-

Mailed:
October 27, 1978

Lewis engineers believe that large wind turbines can become a cost-competitive source of non-depletible electrical power and that the time is right for additional industrial equipment designers and producers to become involved in the nation's wind energy program, a potentially large market.

G. Mervin Ault, director of energy programs at Lewis, stated: "Our work has shown that large wind turbines are closer to meeting utility energy cost requirements than any other electric power system option available today.

"This, plus the fact that our country has vast areas with suitable winds means that large wind turbines could supply a meaningful portion of the nation's future electricity needs. However, at their present state of development, these large machines are expensive to build, operate and maintain. Clearly the costs need to be reduced. What is needed is expanded participation by American industries to simplify wind turbines and to bring down the costs by mass production techniques."

Two advanced design wind turbines are planned. The first is a 200-kilowatt wind turbine optimized for operation at wind speeds lower than the wind turbines presently being installed. The second is in the 1,000- to 4,000-kw range that will produce electricity at a reduced cost per kilowatt hour.

-more-

At the January conference many elements of the nation's wind energy program will be discussed including objectives, present status of the technology, and current cost projections. Particular attention will be paid to designs of and experience with presently operating wind turbines, designs in progress for advanced machines, and plans for procurement of new lower-cost wind turbine designs from industry.

For the DOE-utility experiment program, two 200-kw wind turbines are currently in operation with utility networks in Clayton, N.M., and Culebra, Puerto Rico. Another 200-kw machine is being assembled and installed on Block Island, R.I., with operation slated for 1979. A fourth is planned for placement in Hawaii in 1980.

Currently the world's largest wind turbine is being built and shipped to Boone, N.C., for erection and operation next year. This machine has two blades that span 58 meters (190 feet) from tip to tip and a 2,000-kw generator.

Because DOE and NASA studies have shown that larger machines have the potential for better economic return on investment, a 91-m (300-ft.)-diameter machine capable of generating 2,500 kw of power is being designed using the data and experience acquired in the technology development program.

Four of these 91-m (300-ft.) machines will be built and put into utility networks in 1980 at as yet undisclosed locations.

NASA Lewis also has operated a 100-kw experimental wind turbine at its Plum Brook site since 1975 in support of the technology development program. This machine provided valuable test data and experience and has contributed to improved wind turbine designs.

To indicate an interest in attending or to obtain details, companies are requested to write to the Wind Energy Office, NASA Lewis Research Center, 21000 Brookpark Road, Cleveland, Ohio 44135, attention: Dr. Joseph M. Savino.

-end-

NASA News

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For Release:

IMMEDIATE

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Headquarters, Washington, D.C.
(Phone: 202/755-2070)

John Kley
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/982-4955)

RELEASE NO: 78-167

LANDSAT TO ASSIST APPALACHIAN GAS EXPLORATION

NASA has signed an agreement with the Appalachian Regional Commission (ARC) to test and evaluate the use of Landsat data for the identification of high potential gas shale exploration areas in Appalachia's eastern Devonian Shale Region.

Landsat spacecraft orbit at an altitude of about 917 kilometers (560 miles), surveying the Earth's surface to obtain remotely-sensed data in various bands of the energy spectrum (visible and near infrared). This data, in the form of images and computer-compatible tapes is proving useful to a wide range of interests -- agriculture, geology, forestry, range resources, mapping and charting, land use management and water resources.

-more-

Mailed:
October 27, 1978

The Appalachian Regional Commission is a consortium of 13 member states: Ohio, Kentucky, West Virginia, New York, Pennsylvania, Tennessee, Virginia, Alabama, Georgia, Maryland, Mississippi, North Carolina and South Carolina, plus a federal co-chairman appointed by the President. Its objective is to build a better economy in the Appalachian Region. This ARC project is one of a series under NASA's Landsat Application Systems Verification and Transfer (ASVT) program.

Appalachia, an area of nearly 518,000 square km (200,000 square mi.) and 19 million inhabitants, is rich in natural resources -- but it has never reaped the full rewards of its natural wealth. For many years the region has suffered from economic distress.

The Devonian shales with which this project is concerned are under an area extending from the Mississippi Basin to the Appalachian Mountains. (Other Devonian shale areas are located in the Michigan basin and under the southern parts of Indiana and Illinois and western Kentucky.) Formed about 350 million years ago, their multitude of plants and animals are preserved in a rich organic legacy of natural gas. The gas is found in sealed fractures (cracks in the Earth's crust).

These fractures are easy to find when visible on the Earth's surface, but it takes sophisticated measuring and sensing devices, such as the Landsat spacecraft, to detect and measure them when they lie beneath the surface, as they do in this region.

One of the unique features of Landsat imagery is that it enables geologists to locate and identify large faults and fractures which a ground or aircraft observer would see only small portions of and hence fail to recognize as a general regional pattern.

The Landsat data would be used specifically in ground features analysis in three test areas:

- At the intersection of Ohio, Kentucky and West Virginia, centered at Huntington, W.Va.
- Bordering New York and Pennsylvania, east of Lake Erie, centering at Bradford, Pa.
- Intersection of Kentucky, Virginia and Tennessee, centering east of Middleboro, Ky.

The data would be used to locate and identify linear traces on the surface which would denote possible underlying faults and fractures as likely drill sites.

-more-

The ARC and its member state agencies and associated institutions can then use these data in the evaluation of areas which show high potential for natural gas exploration and associated development. Evaluation techniques and test phase information will be provided to geologists and planners in state offices and other organizations having similar needs.

The memorandum of understanding between the ARC and NASA was signed by Robert W. Scott, ARC Federal Co-Chairman, and Dr. Anthony J. Calio, NASA's Associate Administrator for Space and Terrestrial Applications. Project managers are Hugh B. Montgomery of the ARC in Washington, D.C., and Arthur T. Anderson of the Applications Directorate at NASA's Goddard Space Flight Center, Greenbelt, Md.

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NASA News

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Headquarters, Washington, D.C.
(Phone: 202/755-2070)

IMMEDIATE

RELEASE NO: 78-168

SEASAT FAILURE INVESTIGATION BOARD NAMED

Members of the board to investigate the recent failure of the Seasat spacecraft were named today. In a previous announcement, Dr. Bruce Lundin, former director of NASA's Lewis Research Center, Cleveland, Ohio, was named chairman of the investigation board.

In addition to Dr. Lundin, the full members are: Parker V. Counts, Science and Engineering Department, Marshall Space Flight Center; James E. Hannigan, Flight Control Division, Johnson Space Center; Maj. James T. Mannen, U.S. Air Force Space and Missile Systems Organization; T. Bland Norris, Director of the Astrophysics Division, NASA Office of Space Science, NASA Headquarters; Daniel J. Shramo, Director, Space Systems and Technology, Lewis Research Center; James E. Stitt, Director of Electronics, Langley Research Center.

-more-

Mailed:
October 30, 1978

Affiliates to the board are: Merland L. Mosenson, Director of Flight Assurance, Goddard Space Flight Center liaison; Charles H. Terhune, Deputy Director, NASA Jet Propulsion Laboratory, JPL Liaison; Robert F. Kinberg, NASA legal counsel; and Dell P. Williams, NASA Office of Aeronautics and Space Technology, Executive Secretary.

In a letter to Dr. Lundin naming the board members, Dr. Alan M. Lovelace, NASA Deputy Administrator, cited the importance "that the board move as expeditiously as possible, consistent with a through analysis of the facts, to determine the actual or probable causes of this mission failure." Dr. Lovelace further assured Dr. Lundin that appropriate NASA resources and all background information would be made available to the investigation board members.

The NASA document establishing the board charges members with the responsibility to:

"(1) Determine the actual or probable cause(s) of the Seasat mission failure and document the technical and management history of such cause or causes.

"(2) Provide a final written report to the Deputy Administrator.

"(3) Carry out any other responsibilities that may be requested by the Deputy Administrator."

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
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Nicholas Panagakos
Headquarters, Washington, D.C.
(Phone: 202/755-3680)

IMMEDIATE

John Kley
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/982-4955)

RELEASE NO: 78-169

NASA TO RELEASE ORBITAL CLOUDS

Weather permitting, NASA plans a scientific experiment which will release large, bluish-white, luminescent clouds of barium in the skies over Alaska beginning Saturday, Oct. 28. The Project CAMEO clouds are expected to be visible to residents of Alaska, eastern Russia, western Canada and the northwestern United States.

The chemical release experiments will be activated from the orbiting second stage of the Delta rocket that was used Tuesday, Oct. 24, to launch the Nimbus 7 satellite into polar orbit.

-more-

Mailed:
October 30, 1978

Project CAMEO (Chemically Active Material Ejected in Orbit) involves, in addition to the release of barium over Alaska, a release of lithium over northern Scandinavia at a later date.

Although NASA has conducted many high altitude sounding rocket chemical cloud launches throughout the world, this is the first from an orbiting vehicle. The Delta second stage is in a circular, near-polar orbit of about 950 kilometers (590 miles) altitude.

The Delta stage will be speeding from north to south when four barium canisters are released in sequence during Arctic twilight, or early morning hours, to insure the best lighting conditions for ground photography and other low altitude observations. The ejection command will come from NASA's tracking station at Gilmore Creek, Alaska.

Both barium and lithium are harmless chemicals which rapidly dissipate in space. But it is the pattern in which they spread which scientists hope will reveal some of nature's secrets. The primary objective, for example, of the barium experiment, is to trace the complexities of the flow of ionized particles in and above the Earth's ionosphere.

It is believed that the flow of these ions in the polar cap region is highly complex, with eddy-like flow structures and shears -- similar to a smooth-flowing river encountering rapids and breaking into smaller, faster-flowing channels and whirlpools. To trace the flow in a river, one might spread a streak of dye and follow its progress. The barium ions serve a similar purpose.

The four barium releases, occurring at 40-second intervals, will lay out four streaks of visible, bluish-white, luminescent ions about 1,000 km (621 mi.) long. They should stretch from roughly 74 to 65 degrees North Latitude across the northeast coast of Alaska and extending south southwest over central Alaska. Alaskan cities along the path include Fort Yukon, Fairbanks, Nenana and Holy Cross.

The expanding and upward-moving "draperies," or sheets, are expected to be visible to the naked eye. However, to obtain the desired technical data, the motions and distortions of these sheets must be photographically recorded. For this purpose, camera stations will be located at three Alaskan sites: along the Arctic coast, and at Gilmore Creek and Fort Yukon.

The NASA Lear Jet also will be operating out of Fairbanks. Because several sites require clear visibility, the experiment may be postponed from day to day because of cloud cover over these sites.

CAMEO Project Director is Dr. J. P. Heppner, of NASA's Goddard Space Flight Center, Greenbelt, Md., who will be at the Gilmore Creek site for the barium firing command.

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